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[OFFICIAL NOTICE.]

Wrinkle Department, Pacific Coast Gas Association.

MERCED, CAL., March 11, 1898.

To the Members of the Pacific Coast Gas Association: At the last meeting of the Pacific Coast Gas Association to me was delegated the duty of collecting and presenting any matter, in the shape of original ideas or special devices, which may come under the head of "Wrinkles," to be presented in proper form for the benefit of the Association at the next regular assembly.

Many of our members having charge of gas plants on the Coast have many plans, that are practical, handy and labor-saving, which many others by force of circumstances have never seen, but who, on presentation of the device, drawn and described, or through the medium of our official organ (the AMERICAN GAS LIGHT JOURNAL), would gladly embrace the opportunity, and put into practice a plan very beneficial—which perhaps had been in use in some obscure place many years, used exclusively by one man—that would, when given daylight, benefit the whole gas fraternity.

On reading this communication, please see if you have not forgotten something in the shape of a "Wrinkle," that is doing good service in your works, that would be of great importance to the Association. Your answer to this will greatly oblige.

GEORGE H. HOLLIDGE,
Editor "Wrinkle" Department.

[Special Editorial Correspondence.]

THE TWENTY-FIRST ANNUAL MEETING OF THE WESTERN GAS ASSOCIATION.

RUSSELL HOUSE, DETROIT, MICH., May 18th, 1898.

Dear JOURNAL: The first day's sessions of the coming-of-age meeting of the sturdy Western Gas Association have been successfully completed, and the preliminaries thereto and the records thereof were something on this order: The Eastern delegation, after a very pleasant journey, reached Detroit shortly after noon of yesterday, and were greeted at the depot by a select division of the Entertainment Committee, headed by President Lynn, Colonel Croul and private Baxter, who escorted us to a specially reserved trolley car, for transportation to the Russell House. The front seats of the car were occupied by five German musicians, who manipulated to the best of their ability brass horns of one sort or another. One of the Entertainment Committee explained that the band had formerly a large membership, but the people of the city had gradually "killed them off." The Russell House was reached in due time, and even then its lounging rooms and corridors were plentifully dotted with gas men from almost everywhere. Conversation and interviewing reveal the fact that the Western gas men are pretty well satisfied over the state of trade, substantial gains being frequently reported A good night's rest under Mine Host Chittenden's hospitable roof put everybody in right trim to go on with the regular business of the meeting. The room selected for holding the sessions was the Ladies' Ordinary, on the second floor of the hotel, and it suited its use to the satisfaction of all. At 10:20 A.M., President Lynn called

the meeting to order and introduced the Mayor of the city (Mr. Wm. C. Maybury), who welcomed the Association in hearty fashion and extended to the delegates the "freedom of Detroit." Capt. W. H. White, in his usual suave method and witful speech, acknowledged the Mayor's courtesy. The regular order of business was then taken up. Vice-President Thompson assumed the Chair while President Lynn read his inaugural address. It was quite like its author, practical and to the point, and it was listened to with close attention. President Lynn, on reassuming the guiding reins, here appointed some special committees, after which many new members were elected. A feature of this proceeding was the election to honorary membership of Mr. Charles H. Nettleton, of Birmingham, Conn. After the new membership had been introduced (Mr. Wm. McDonald "doing the honors,") the report of the Board of Directors was read. It showed that another paper, in addition to those regularly listed in the preliminary official notices, had been submitted. It was by Mr. Frederick Egner, and its title was, "Hindrances to the Adoption of Inclined Retorts in America." The report recommended the adoption of the amendment to the Constitution, proposed last year by Mr. Chollar, to permit associate members to have the right to vote, and also advised that the proceedings of the Association be published in book form, the volumes to commence with the records of 1896-97-98, the records of the prior years to be published later on, as speedily as the funds at the disposal of the Association would admit. The report of Secretary and Treasurer Dunbar was included in the report of the Directors. The vote on the suggested constitutional amendment was put over to a later hour, and the balance of the report was adopted, after which a recess was ordered. The attendance right from the earliest was excellent and thoroughly representative.

When President Lynn called the meeting to order 135 members and guests listened to his announcement. The Association reconvened at 2 P.M., and the proceedings were commenced by the reading of the paper, by Mr. George H. Harper, of Altoona, Pa., who addressed himself to the matter of "The Enrichment of Coal Gas." The paper was in Mr. Harper's best method, which is virtually saying that it was practical, lucid and interesting. A feature of the discussion of the paper was the presentation by Mr. W. W. Goodwin of a written contribution on the enrichment of coal gas by acetylene. The veteran's lines were read by Capt. White, and Mr. Goodwin's deductions from his experiments on the line indicated added greatly to the value of the debate in hand. Mr. C. W. Blodget, of Brooklyn, N. Y., then read a well put together paper, on "The Use of Gas for Purposes Other than Lighting," which provoked an extremely practical exchange of opinion regarding the best means of extending the gas trade. Mr. C. H. Raynor, of Adrian, Mich., followed with his timely notes on "The Prepayment Meter." His paper brought on another very interesting discussion, the weight of which was altogether in favor of the placing of the coin-collecting automatic gas measurer. General Harbison, however, dissented somewhat from the ruling sentiment of the discussion. The paper by Mr. T. D. Miller, of Dallas, Texas, on "Recent Developments in Texas of Interest to Gas Men," next occupied the attention of the members, after which the Association adjourned until 8 P.M. The evening session was held for the purpose of electing office bearers for the ensuing year, and the following was the outcome of the balloting:

President—Mr. Geo. T. Thompson.
First Vice-President—Mr. I. C. Copley.
Second Vice-President—Mr. Wm. McDonald.
Directors, to serve two years—Messrs. Eugene Printz, T. D. Miller, Howard Slater and Irvin Butterworth; to serve out the unexpired term of Mr. Wm. McDonald, Mr. James Forbes.

Messrs. Thompson, McDonald and Dunbar made clever speeches in acknowledgment of "the honors put upon them," after which the first day's sessions were declared at an end. The "rainy season" was almost as much in evidence in Detroit to day as it has been in evidence in the East for the past three weeks, but all the water in the great lakes would not be enough to even dampen the interest shown by the members in making the coming-of-age meeting of the Western a rousing success.—C.

RUSSELL HOUSE, May 19th.

Although I am preparing this for transmission at 2 P.M., it is nevertheless a fact that all the technical business of the meeting has been finished; nor was a number on the programme slighted, which goes to show how clever a presiding officer Mr. Lynn proved himself, and how attentively the members held to their work. The session was begun in rain but ended in sunlight, which augurs well for the comfort of the fair sex (many of whom graced the meeting with their presence), who are this afternoon to make a trip on the steam yacht *Cynthia* around beautiful Belle Isle and down the river, landing at the Detroit Stove Works, thence back to the Russell House on special trolley cars. The first paper read this morning was that by Mr. Bankson Taylor, of St. Paul, Minn., who related an interesting experience of an "Ignition of Gas by Static Electricity." Milwaukee, Wis., was then selected as the next place of meeting, and the following routine business was transacted: Acceptance of the report of Committee on President's Address, adoption of the constitutional amendments previously noted in my dispatches of yesterday, reading of letters regretting the inability of the writers to be present at the meeting; final roll call—which showed a total attendance of 160; report of Committee on Memorials—this was adopted by a rising vote, and the election of 10 additional new members. The round-up of members elected this year (24 active and 7 associate) shows better than anything else could the vitality and worth of the Western Gas Association in its relation towards progress in the gas industry. The paper list was again taken up, Mr. O. O. Thwing, of St. Louis, Mo., reading an excellent number on "Methods of Estimating Values of Gas Liquors." The discussion on Mr. Thwing's paper was followed by the paper by Mr. Frederick Egner, of Norfolk, Va., who gave a sensible and connected report or statement of some "Hindrances to the Adoption of Inclined Retorts in America." That the inclined retort system is taking firm hold in thoughtful gas engineering minds on this side of the water was well shown in the discussion of Mr. Egner's paper. Editor E. H. Jenkins, of Buffalo, N. Y., was then called upon to smooth out his budget of "Wrinkles," which he did to the complete satisfaction of his hearers. In fact, so well was it held that his work had been thoroughly done, that the Association paid him the unusual compliment of a rising vote of thanks. The paper by Mr. George T. Thompson, of New York, entitled, "Some English Correspondence upon Isolated Generators for Bench Firing," was read. It led to a rousing discussion, in which many differing opinions were expressed, that eventually terminated in the appointment of a committee directed to compile information on heating settings by means of outside generators, the committee to report at the meeting next year. The report of Committee on Final Resolutions was then disposed of, and the Association adjourned, to come together again at 11 A.M. to-morrow, which is the hour named to board the boat for the proposed excursion through Lake St. Clair and the balance of the exceedingly interesting route laid out by the Entertainment Committee.—C.

RUSSELL HOUSE, May 20, 1898.

Dear JOURNAL: The boat ride of yesterday afternoon was a complete success, not a thing happening to mar the thorough enjoyment of those who participated in it. Although in these dispatches I have not said much about the social side of the meeting, it is nevertheless true that the Entertainment Committee has seen to it in every way that those present have not had a dull waking moment. At this time (10:30 A.M.) the steamboat *Promise* is being boarded by the voyagers who propose to share in the Western's outing, a scant outline of which was given in my closing lines of yesterday. The skies are cloudy and the temperature is high, but the spirits of the voyagers are full of strength in the belief that rain will not weaken their ardor.—C.

NOTES.—At the annual meeting of the Lawrenceburg (Ind.) Gas Company the officers chosen were: President, George Roberts; Vice-President, T. W. Isherwood; Secretary, S. Isherwood; Treasurer, D. Isherwood; Supt., Jas. Isherwood—quite a family affair.——The Suffolk County Gas Company, of Bay Shore, L. I., was sold at receiver's sale on the 14th inst. The property was bought in by Messrs. Street, Wykes & Co., for the bondholders. A new Company is now forming, to be called the Suffolk Gas and Electric Light Company, for the purpose of absorbing the existing electric light and gas plants at Bay Shore.——The Jenkintown (Pa.) Borough Council has agreed to permit the Jenkintown and Cheltenham Gas Company to pipe the town.——The proprietors of the Leavenworth (Kas.) Light and Heating Company have agreed to make a net rate of $1 per 1,000 cubic feet, the concession to date from June 1st.——Some days ago, Judge Morrow, in the United States Circuit Court, San Francisco district, dismissed the bill of complaint and taxed the costs to the plaintiffs, in the suit of the Union Gas Engine Company, M. M. Barrett and J. F. Daly, against John E. Dook. It was alleged that the defendant infringed the Barrett and Daly patent for apparatus to ignite gas in gas engines by means of an electric spark. The Judge decided that as this device was anticipated the patent was void for want of novelty.

Economical Methods of Raising Steam in Gas Works.

[A paper read by MR. C. D. DRURY, of Sunderland, before the North of England Gas Managers' Association.]

Engineers and managers of gas works often have it cast up against them that they, who are always urging the use of gas engines among manufacturers, do not themselves use them—or, at any rate, employ them only to a very limited extent. If gas companies, it is said, who can have their gas at cost price, do not use it as their motive power, how can the public in general be expected to take it up?

While sympathizing with these sentiments to a large extent, the cause for the reproach is not difficult to find. Steam is an absolute necessity in a gas works of any size. It is required for steaming out the mains and various portions of the works plant, and also in connection frequently with the revivification *in situ* of oxide of iron in purifiers, and, where sulphate of ammonia is manufactured, for boiling the liquor. In winter, of course, its usefulness is increased, as there is the meter house to maintain at an even temperature and also the prevention of freezing in the lutes of purifiers and gasholders, etc. These uses for steam are, however, more or less intermittent; and it is found more economical and practicable, since boilers are required, to make them large enough to provide steam for the daily requirements—such as the driving of exhausters, pumps, etc.—as well. Also the growing practice among gas engineers of manufacturing water gas on their works increases the demand for steam; and thus it comes to pass that even in newly constructed works, in spite of the adaptability of gas engines and the great improvements that have been made in them, steam is still employed as the great motive power.

But there is another point of view from which to look at this question of steam using, and one which, in my opinion, is most important—viz., the cheapness with which steam can be raised in gas works. A certain quantity of dirty or small fuel is, like the poor, always with us; and this is either valueless and has to be carted away—perhaps at considerable cost—or commands so small a price as to be practically unremunerative. This can and should be used for raising steam. Now, what is the fuel which can be dealt with as suggested?

First of all—and there should not be much of this class in a well regulated gas works, although it mounts up when taken over a year's working—there is the coke swept up in the yard, or thrown up from the railway siding, or picked out from the furnace ashes. It is not advisable to mix this with the best coke, as it is generally small, wet and dirty, and leads to tiresome complaints on the part of customers. In many cases, too, the pan breeze screened from the furnaces is added; and this, of course, reduces the cost of carting away the residual ashes. But unless there is ample accommodation for carrying on the operation, this process is somewhat inconvenient.

Next there is the coke breeze, which rarely fetches more than 37 cents per ton, and except in a few favored localities is very difficult to dispose of. When burnt, however, by means of a forced draught in a special furnace, of which there are several varieties in the market, it forms an excellent fuel for boiler purposes. No attempt will be made to describe a breeze burning furnace in detail, as no doubt every member of this Association has either seen them in operation or has one or more of them at work himself. I regret that I am unable from practical experience to give any figures showing the working results of any such furnace. I understand, however, that an evaporative duty of from 5 to 7 pounds of water per pound of breeze is claimed for them; and there is little doubt that where a plentiful supply of breeze exists—and such, of course, is the case in gas works—the outlay necessary for a breeze furnace is a profitable one.

A third method of raising steam economically (and the description of this is really the essence of this paper) is that of heating the boiler by means of the waste gases from the retort settings. And here I would beg leave to mention that, in bringing this method before the notice of the members of the Association, I make no claim for originality or for the introduction of anything novel. I merely wish to refresh their memories on the subject, and to draw their attention to the simplicity and economy of the process. I quite anticipate that many present will consider this plan of raising steam obsolete, since, owing to the very general adoption of regenerative (or more properly, recuperative) furnaces, there is not sufficient heat in the gases leaving the setting for the purpose; and also that it will be said that it is more desirable to utilize as far as possible all the furnace heat in the setting itself, than to produce more than is required and use the balance for some other purpose. To this I, to a great extent, agree, as I am a firm believer in the advantages and merits of generator, if not regenerative, furnaces—especially on the points of use in regulating the heats and increased life on the retorts. But for all that, there are many works where it is not expedient or advisable to convert a whole retort house of direct fired settings to the more improved principle, especially if the existing furnaces are doing good work.

In the works at Sunderland under my charge, the whole of the settings are on the direct fired principle; but in spite of this fact, the amount of coke (not coke and breeze) sold per ton of coal carbonized amounts to 10¼ cwt. taken over a year's working. This result is largely due to the fact that the greater part of the steam used on the works is raised in boilers heated by the waste furnace gases, by which means the settings affected are, in a sense, converted into the regenerative type. There are at present three boilers heated in this manner, and a fourth is in course of erection. Of the three, two are tubeless, cylindrical, egg-ended boilers, 4 feet in diameter and 36 feet long, while the third is a Lancashire boiler 27 feet long. Experience shows that the latter type is by far the most efficient.

The system of overhead gas fired boilers was inroduced into the Sunderland works by one of my predecessors, Mr. J. T. Jolliffe, a former member and Past-President of this Association; and with a few modifications, the system is still worked in the same manner.

A glance at the diagram on the wall will show that the boiler is hung, so as to prevent its weight being carried by the arches of the settings, and thereby distorting them, from cross girders supported by cast iron columns rising from the ground on each side of the bench; the only extra weight falling on the beds being that of the walls enclosing the boiler flues. The bench over which the boiler is suspended consists of nine settings of eight through retorts each, of which the arches are 8 feet wide by 19 feet long. Of these nine settings, seven are connected to the flues of the boiler. It is found that the waste gases from four settings are sufficient to work the boiler satisfactorily. But, of course, better results can be obtained with the heat from seven beds; and this arrangement allows of the settings being let down in two's and three's for repairs, without laying off the boiler. The course of the waste gases is from the main flue through the tubes returning under the bottom of the boiler to the chimney. Dampers are provided for bye-passing the boiler altogether, when it is required to lay it off for cleaning, etc., in which case the gases pass away direct to the chimney.

The dimensions of the boiler are as follows: Length, 27 feet; diameter, 7 feet; the two tubes being 2 feet 6 inches diameter. There are no cross tubes. The following fittings are provided: One 3-inch dead weight safety valve; one compound steam and low water safety valve; one 6-inch steam stop valve; one 2½-inch feed valve; one 2½-inch blow out valve; one steam pressure gauge; two glass water gauges, placed so that when the water in the boiler is 3 inches above the tubes it is just in sight in the glass; one ¾-inch brass tester cock; one manhole; and one mudhole. There are, of course, no fusible plugs, as they would be quite useless in this case. A small duplex feed pump is fixed in the retort house, close to the boiler, for supplying the water; and the gauge glasses are placed in such a position that they can be easily seen by the retort house foreman, in whose charge the boiler is placed, and who is paid a nominal sum for looking after it. His duties consist in regulating the feed water supply, and in sludging the boiler once per shift.

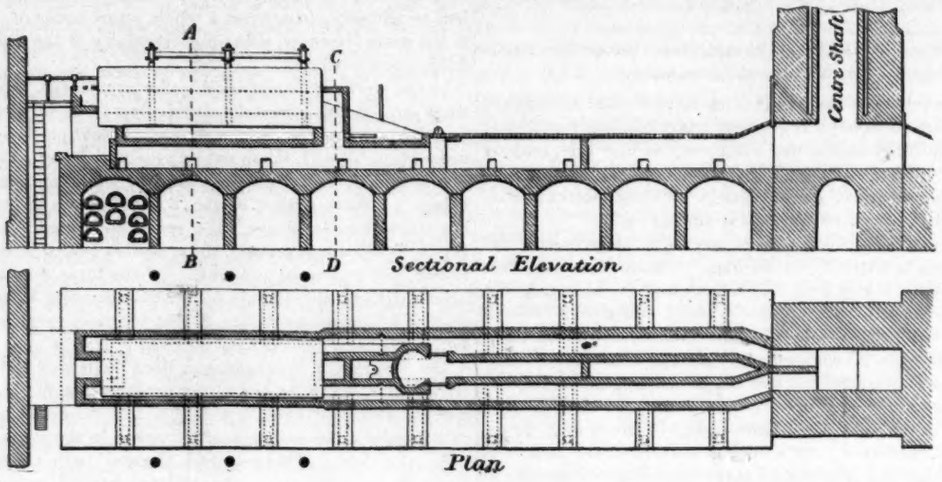
The cost of such a boiler erected and set is as follows: Boiler and fittings, $1,350; columns and girders, $630; erecting and setting, about $650; feed pump, about $120—or a total of $2,750. The extra cost of suspending is, of course, much more than compensated for by the fact that no house or chimney is required to be erected.

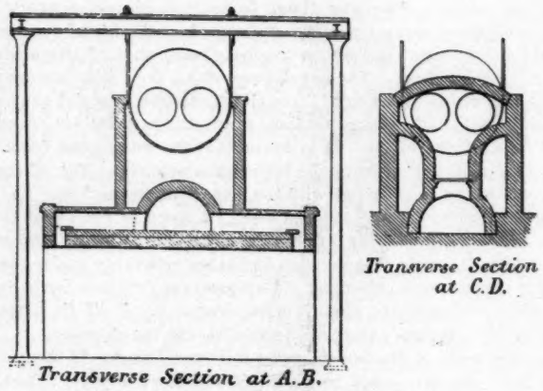
A number of experiments were made to ascertain how much work could be got out of this boiler when the waste gases from seven settings were being passed under it, with the following result:

Duration of test.....	8 hours.
Water evaporated	1,890 gallons.
Temperature of feed water.....	48° F.
Average pressure of steam	32 pounds per sq. inch.

In other words, in 8 hours 18,900 pounds of water were raised from 48° to 267½° F., and evaporated at this temperature. The next step was to find the amount of coke which would have been necessary to do this work; and not considering it sufficiently satisfactory to assume an evaporative duty per pound of coke, experiments on the same lines as the preceding were made with a hand-fired Cornish boiler 20 feet long by 5 feet 6 inches diameter—diameter of tube, 3 feet. Results were as follows:

Duration of test.....	8 hours.
Water evaporated.....	1,870 gallons.
Temperature of feed water.....	52.5° F.
Average pressure of steam.....	30.5 lbs. per sq. in.





Or in eight hours 18,700 pounds of water were raised from 52½° to 274½° F., and evaporated at this temperature. The amount of coke consumed during the period was carefully weighed, and proved to be 1 ton 21 pounds, from which it was found that 8.27 pounds of water were raised through 222° F. and evaporated by 1 pound of coke. The fuel used was best coke, brought straight from the retort house, but not selected in any way.

Correcting the figures obtained in the experiment with the Lancashire gas fired boiler to the temperatures in the latter experiment, the weight of water evaporated works out to 18,975 pounds, and therefore the amount of coke saved in eight hours on the preceding basis is 1 ton 1 qr. 26 pounds, or about 20 tons per week of 6½ days.

Besides the value of the coke, there is also saved the greater part of an attendant's wages; and assuming the cost of labor that would be required to be equal to $1.12 per day of 24 hours, and taking the value of coke at the low price of $1.50 per ton, the actual saving per week by this gas-fired boiler is—

Coke saved, 20 tons, at $1.50		$30.00
Labor saved, 7 days, at $1.12	$7.84	
Less foreman's allowance.	2.72	
		5.12
Total saving per week		$35.12

Now the retort settings are under fire for an average period of 33 weeks in the year; and therefore the total saving per annum by this one boiler is $1,163.25.

Here I may say that, though due care was exercised, and the necessary precautions taken to avoid error, the foregoing experiments were conducted on strictly "working" lines; and the results are such as may be obtained any day of the week. It may be urged that a fair comparison cannot be obtained between a 27-feet Lancashire boiler and a Cornish one 20-feet long; but I feel sure, at any rate, sufficient evidence has been produced to show that the economy effected is not inconsiderable.

To complete the information respecting the gas fired boiler, temperatures of the waste gases were taken in the main flue before and after passing under the boiler. A number of tests were made, and the results varied according to the condition of the fires in the settings. But all showed that the boiler effected a reduction in the heat of about 700° F.

The temperature before passing under the boiler varied from	1,337°	to	1,130° F.
Do. after passing under the boiler	645°	"	420° F.
Difference	692°	to	701° F.

The above temperatures were obtained by means of a Siemens water pyrometer; and to those requiring such an instrument, it can be highly recommended for reliability and simplicity of working. Perhaps it will not be considered out of place if a brief description of it is here given.

The pyrometer consists of a cylindrical copper vessel, containing a second smaller copper vessel with double walls. An air space separates the two vessels, and a layer of felt the two walls of the inner one, to prevent radiation of temperature. The capacity of the inner vessel is a little over one pint. A thermometer is fixed close to the wall of the inner vessel, its lower part being protected by a perforated brass tube, while the upper projects above the vessel, and is divided into degrees Fahrenheit or Centigrade, as desired. At the side of the thermometer is a small brass scale, which slides up and down, and on which the high temperatures are marked in the same degrees as those in which the thermometer is divided. On a level with the zero division of the scale, a small pointer is fixed, which traverses the scale of the thermometer. Short cylinders, of either copper, iron or platinum, are supplied with the pyrometer, which are so adjusted that their heat capacity at ordinary temperature is equal to one-fiftieth that of the copper vessel filled with one pint of water.

The method of using the instrument is as follows: Exactly one pint of clean distilled or rain water is poured into the copper vessel, and the pyrometer left for a few minutes to allow the thermometer to attain the temperature of the water. The brass sliding scale is then set with its pointer opposite the temperature of the water, as shown by the thermometer. Meanwhile, one of the metal cylinders has been exposed to the high temperature which is to be measured, and after allowing it time to acquire that temperature, it is rapidly removed and dropped into the pyrometer vessel, without splashing any of the water out. The temperature of the water will now rise, and after the thermometer has become stationary, the degree is read off, as well as that on the brass scale opposite the top of the mercury. These two values added together give the temperature to which the cylinder has been exposed. With copper and iron cylinders, temperatures at 1,800° F. can be measured; but with platinum cylinders the limit is 2,700° F.

In course of time the copper cylinders lose weight by scaling; and a table is supplied with them with corrections for the diminished weight.

Before concluding, I earnestly trust no one will consider that there is the least intention in this paper of disparaging the gas engine, or of throwing doubts on its usefulness in gas works. On the contrary, I would strongly advocate its use in every gas works, provided that a supply of steam is also obtainable; and on those works where only steam engines are employed, a gas engine should be introduced at the earliest opportunity, if only to encourage the use of it by others. That gas engines may be used wherever steam engines are employed, needs no demonstrating; and even in the delicate and fluctuating work of driving an exhauster, a gas engine may be safely and economically

made use of, as Mr. Dunn at our last meeting so ably showed by means of his ingenious contrivance.

I have a fear it may be felt that, apart from its want of novelty and originality, this paper has, if not a backward tendency, a more or less ancient flavor. But I make no apology; for history repeats itself, and the old fashions of yesterday become the new ones of to-morrow.

Discussion.

The President thought they might congratulate themselves upon having had that day two eminently practical papers. He did not think that Mr. Drury should have made any apology with regard to his paper, because it was full of new information—at least it was so to him. It contained a number of facts which would be useful to every one of them in their ordinary everyday work.

Mr. E. H. Millard (Durham) said he had known two places where the method of raising steam as described in the paper had been in use. They were both works considerably smaller than Mr. Drury's. He himself had had practical experience with one, where there was an egg-ended boiler; and it was not satisfactory. In the summer time there might be three or four beds of retorts at work, and there was not sufficient heat to generate steam. In the winter time, with the extra draught which was required to be put upon the beds, there was absolutely no economy in the raising of steam in this way. He was surprised that in such a place as Sunderland it should be considered that this was equal to a regenerative system in the saving of fuel. Mr. Drury's results were, however, very good; and perhaps the price he got for coke did not commend the other system to him. But he (Mr. Millard) should think that economy in heating could be better obtained by means of regenerative furnaces, than by raising steam in the way described. The boiler was certainly not in a convenient place for working.

Mr. A. C. Hovey (Tynemouth) inquired of Mr. Drury whether 32 pounds was the maximum pressure he was able to maintain by a boiler fired in this way; and, if it was the maximum pressure, if it was the pressure he employed in his works, and if all his machinery was suitable for such a low pressure. He should also like to ask the minimum number of beds he could fire the boiler with; and he should like to draw attention to the distance which the boiler would probably be from the engine house, and the great drop in pressure there was likely to be, owing to the distance the steam would have to travel.

Mr. Herbert Lees (Hexham) expressed his appreciation of the paper Mr. Drury had brought before the meeting. He could do this the more heartily as he had the opportunity some years ago of placing the other side of the question before the Association—that was the production of motive power by means or gas engines. He thought an arrangement of the sort referred to in the paper would be no use in a works of (say) from 10 to 14 millions per annum; but he had no doubt that the facts which Mr. Drury had put before them fully justified his adoption of it. Of course, Mr. Drury had told them that he approved of regenerative furnaces; but, taken altogether, the results at Sunderland were so satisfactory that they could afford to consider the matter on its merits. He was very glad that Mr. Drury had brought the subject before them. It would be no use to any of them in small works, because at some seasons they would only have one or two beds of retorts working, and, even with a very small boiler, he presumed that sufficient heat could not be obtained by the method described. A gas engine also did away with the need for a boiler fireman. Where a man had to be kept to look after the boiler, his (Mr. Lees') experience had brought him to the conclusion that they could work more economically with gas. However, there were both ways of working, and they all wanted to look at these matters from their own standpoint. When they could do this, and could bring to bear on the subjects all the information they could get, they should probably be able each to adopt what would be suitable in his own case.

Mr. W. Ford (Stockton) complimented Mr. Drury on his paper. Some little time ago, he was traveling in Yorkshire in search of electric lighting, and he came across an instance where the whole of the heat required to drive the installation was obtained in the way shown; so that, if they got the heat Mr. Drury did, he could only say the matter was worth their attention.

The President said he was at one with Mr. Lees as to its being considered old-fashioned to continue direct fired furnaces. He had the two kinds in his works, and he was not quite sure that he could not get as good results out of the direct fired furnaces as he did out of the regenerators. It might be rather a retrograde remark to make in the year 1898, but he did not know that there were not two sides to the question, and he thought that if Mr. Drury were obtaining the good results he was doing by direct fired furnaces, and utilizing the heat in this way, he was probably getting compensation for the heat which would be used in a regenerative system. As to the disposal of breeze, in Scarborough they sold the whole of it to the electric light people for generating steam. They were proposing to put in a destructor, by the aid of which they were to supply electric light at something like nothing per unit; and he supposed he would have to look for another market for their breeze when that time came.

Mr. Drury, replying to Mr. Millard, said he did not for a moment contend that this was nearly so good a way of recovering heat as was a regenerative setting, which he thought was far better, from a good many points of view; but when he found two houses of retorts, and knew that it would require a large sum to convert them into regenerative settings, and that the erection of this boiler would get them the heat in a simple way, he thought he was justified in adopting this system. They were selling 10½ cwt. of coke per ton; therefore he thought he was justified in continuing this method of raising steam. He was asked about the pressure of steam. The maximum was 32 pounds; and all his machinery was arranged for working at it. No doubt, if a time came when they should raise the pressure, the boiler could be worked at 50 pounds. The minimum number of beds to be used was four. They were throughs. With less than four beds they would make such wet steam that it would not be workable. Of course, there were disadvantages in having a boiler like this, in that they had sometimes to work settings which were not conveniently situated relative to the boiler. But as he was going to have two Lancashire boilers, he would get over this difficulty pretty well. As to the distance the steam had to travel, they used steam for so many purposes and in so many places that it really did not much matter where they put the boiler. They would, no doubt, raise a good deal more steam than they did, if they arranged the flues for this purpose; but the first consideration was not to damage the beds in any way, or reduce their heat, by altering the flues. They made their beds so as to work as economically as they could; and then they used the waste heat of the gases. He was much surprised at one time, to be told that when the boiler was at work there was a better draught on the settings than when it was off. The reason for this he found to be that, when the boiler was off and the dampers were closed, there was behind the dampers an accumulation of dust and dirt which contracted the flue. He thought every gas works should have a boiler which would burn up their breeze.

The Gas Stove Cooking Demonstration from a Gas Manager's Point of View.

[By Mr. Norton H. Humphrys, in the *Gas World*.]

Advertising gas cookers by the aid of demonstrations in the art of cooking is an example of indirect advertising, and it is not alone in proving a greater success than more direct methods. At one of the recent pantomimes, in the course of a burlesqued political oration, the clown asked, "What should we do without the ladies?" to which pantaloon responded "$15 a week better off." Without entering upon the somewhat delicate ground involved in the solution of this problem in a general sense, we may at once grant that if the question had been "What would the gas cooker trade be without the ladies?" the reply ought to have been, "A great many pounds a week worse off." To take a further illustration from another direction, there are certain countries in the world, such as India and China, where the prevalent customs render the services of ladies indispensable in missionary work. Women are able to get into particular circles, and to secure a hearing, where men cannot enter. In like manner, the lady lecturer has obtained attention in a way that would be impossible in the ordinary methods of business. The advantages of the gas cooker have been introduced to all classes. The artisan's wife has learned how to save time and trouble; the business woman has seen that it is possible to cook a dinner and yet be in and out of the shop at the same time; the professional cook has become aware that an agent is available for the most advanced operations of the culinary art, capable of a greater degree of control than solid fuels, involving no risk of dust or smoke, and enabling the kitchen to be kept cool and comfortable in summer weather. The mistress of the well-to-do, high-class household witnesses, with admiration, the reliable character of the various processes, that they can all be timed to a minute, and that the consumption of gas is not necessarily extravagant; while young ladies who desire to become practically acquainted with plain or fancy cookery are glad to have the means of doing so without risk of scorching their faces and hands, or of coming in contact with soot or dust. These are some of the numerous points that

have been made generally known by means of the cookery demonstration, and which cannot be illustrated at the gas works office or in the ironmonger's shop.

The First Gas Exhibition.—The movement was an offshoot and development of the Gas Appliance Exhibition, which has just attained its legal majority in England. The pioneer gas exhibition was opened on Monday, April 9, 1877, at the Free Library Buildings, Ocean Road, South Shields. To the South Shields Gas Company and their Engineer, Mr. W. J. Warner, belong the credit of inaugurating the gas exhibition movement. The opening ceremony was very appropriately performed by Mr. R. P. Spice, in his capacity of President of the British Association of Gas Managers, who said that the occasion was an important one, that would be long remembered in the annals of gas industry of the United Kingdom. A large and influential company, representing the *élite* of the town and neighborhood, was present at the opening, and later in the day a luncheon was served, the whole of the dishes having been prepared at the exhibitors' stalls. The whole proceeding was a great success. The original intention was to keep the exhibition open for three days, but on the morning of the second day a petition for an extension of the time, signed by 500 persons, was received at the gas office, and in response it was continued for two days more. There were seven classes of exhibits; and a silver medal was offered as a prize in each class. In view of more recent developments, the classification adopted by Mr. Warner is especially interesting. The first class was portable stoves, for boiling, frying and grilling, suitable for a mechanic's home, and the remainder were gas cooking stoves, gas baths, closed apparatus for heating halls or conservatories by means of hot air or water, open gas fires, gas engines and novel applications of gas to purposes of general utility. With all the experience now available it would be difficult to improve upon this arrangement.

Aim of the Exhibitions.—Although this was the beginning of distinct and separate exhibitions, as promoted by the local gas company on its own account, gas apparatus had figured on several previous occasions, under the auspices of the sellers of gas, in connection with national or local industrial exhibitions. It is desirable to call attention to this fact, because there is a general impression that the gas exhibition and cooking demonstration movement only dates a few years back, and is the result of the threatened competition of electricity. At the South Shields and other early exhibitions no mention whatever was made of electricity. The chief object in view was to reduce the difference between summer and winter consumption, by increasing the demand during the long days. There may be places where nothing short of threatened competition will rouse the directorate to ordinary business activity, but such is not the general rule. It was apparent to go-ahead managers that something in addition to ordinary business methods was necessary in order to fully develop the gas stove trade, and this assumption has been proved to be quite correct. It was supposed that the gas stove would be chiefly used in the summer, when coal fires were not required for other purposes, but in most cases the stove is used all the year round, and what was regarded as additional summer business has really proved to be more like additional day business.

How the Cookery Demonstrations Grew.—No mention is made of the cookery demonstrations, by which we mean a regular course of lessons given daily, in connection with the earlier gas exhibitions. The success at South Shields led to the holding of similar exhibitions in other towns, usually on the same lines. The luncheon or dinner, consisting exclusively of viands prepared at the stalls in the exhibition, in full view of the public, was regarded as the best method of advertising gas cooking. Sometimes this was served daily throughout the whole progress of the exhibition, and nearly the whole of the gas consumers in the district had the pleasure of taking a free meal at the expense of the gas company. Or the public were invited to send in their own cakes, pastry, or joints to be cooked in the exhibition hall, and thus obtain practical proof of the capabilities of gas. The need for a first-class cook soon became apparent, and in 1879, two years after the South Shields exhibition, we find that the schools of cookery were called in to aid in this work. The lady demonstrator first commenced operations at the exhibition stalls, where she proved a center of attraction to the fair sex, and soon became an inseparable part of the gas exhibition. The necessity for a separate room or hall in which she could address her audience without interfering with the regular progress of the exhibition soon became evident, and at the beginning of the eighties she had acquired the prominent position which she has retained ever since, and the course of high-class demonstrations in the afternoon and plain cooking in the evening, became an established custom.

The Start of Hiring Out.—Another novel feature that was introduced at this time was the system of letting stoves on hire, with various concessions in the matter of fixing, the usual plan being to fix the appliance and supply up to 30 feet of pipe free of charge. Even at the time of the South Shields exhibition the hiring system was established in a few districts, but it was by no means general; and the exhibition became a very convenient means of inaugurating and advertising the introduction of this system. Especially when assisted by a judicious concession in the matter of price of gas, it proved a most successful method of effecting such a result. The large trade thus opened up led to a remarkable degree of spirit and enterprise on the part of the makers of gas stoves. Within the space of a comparatively few years the gas stove blossomed out, from the plain box of sheet iron with a few boiling burners on the top, as our fathers used to know it, to the double-cased, enamel-lined, highly finished article the gas companies are now supplying, with griller, simmering burner, and other improvements. Many agencies have contributed to the successful introduction of gas cooking stoves, in addition to the labors of the lady demonstrator, such as improvements in stoves, reductions in the price of gas, and liberal terms in respect to fixing. No one cause can be separately assessed, as each one acted and reacted upon the others in assisting towards the desired end.

More of Gas and Less of Stoves.—The gas manager is concerned with the increased use of gas, rather than with the sale of gas stoves, and, from his point of view, it is unfortunate that the lady demonstrator, at a very early stage, became almost the exclusive property of the stove manufacturers, with the natural result that the tone of her remarks tended in the direction of "stove first, gas second." The gas was merely the indispensable auxiliary towards the sale of the stove. Whether the stove was sold directly to a user of gas, or placed out on hire, made no difference whatever to the maker. In either case it was sold to the gas company right out and taken off the maker's hands. This is the main object of the demonstration, and there is a tendency to exclude anything that does not point directly to the end. But the eloquence of the lady in the lecture room combined with that of the staff of salesmen in the exhibition has sometimes led to undesirable results. The rush of orders has been such that full inquiries could not be made in each case; and after a few months the gas company finds that valuable appliances have been supplied to unreliable consumers who have but little to cook, that certain easy going folks have been talked into having a stove about twice as large as they really require, or that parties who previously used gas for lighting and did not pay for it have now the satisfaction of cooking their dinners in the gas company's stove on similarly easy terms. The writer should not be misunderstood in mentioning these points; they could be easily adjusted by consultation between the respective representatives of gas and gas stoves beforehand. The enterprise of the stove manufacturer is most commendable, and has resulted in great benefits to gas companies. But the maker only wants to advertise his own particular line, while the gas company have a wider end in view, which may be described as permanently increasing the demand for gas. So it is worth considering whether the gas company should not have a controlling voice in the subject of the lectures, in which case the scope would be extended, and made to include fuller details relating to economical consumption of gas, with a word on gas fires, hints on gas lighting and on the care of incandescent lamps, and on how to guard against loss by leakage, etc. The writer knows of one or two undertakings who preferred to manage the exhibition and demonstration themselves, engaging the lectures on the understanding that the lines above indicated were to be followed, and the result was satisfactory to all—stove manufacturers included.

Business not Amusement.—The manner in which the advantages of gas cooking are now set forth leaves little to be desired, with the exception just noticed. At the first start there was a short period when the gas cookery lecture was scarcely taken seriously, but rather regarded as a sort of fashionable recreation to fill an idle hour before afternoon tea. The aid of smart attire and a stagy get up was not despised by the lecturers, who cultivated a taking style and posed in elegant attitudes while three or four assistants really did the work. But it soon became evident that the ladies who attended the demonstrations meant business and not mere pleasure, and looked for substantial instruction rather than passing amusement. So the drawing room talker gave way in favor of a more practical lecturer, who performed the whole of the operations herself, with the aid of one assistant for rough manual labor.

A recent advance on the gas exhibition and lectures is the Food and Trade Exhibition, which includes, in addition to gas exhibits, a number of familiar proprietary articles of the class that are freely advertised in the newspapers; and the lecturer is expected to make special

reference to these in her remarks. Just as with the free luncheon, where the whole of the viands are prepared at the exhibition stalls, so the lecturer is expected to confine her notice of specialties to those that are on view in the exhibition. Musical performances, the cinematograph, and other attractions are provided, and are successful in drawing a good attendance; but, in the writer's opinion, regarded as a means of extending the use of gas, the food exhibition is of very little use. The people who attend the cookery lectures would do so without the inducements offered by the other part of the programme, which is more likely to attract young persons in search of amusement than the class of customers to whom gas companies look for support. The food and trade exhibition is no doubt a good advertisement from a general point of view; but the gas stove does not benefit by being placed in juxtaposition with cocoas, meat essences and lollipops. The writer holds the opinion that, for the purposes of the gas company, the exhibition and the demonstrations themselves are a sufficient attraction, and that people who need the attractions of pianoforte duets or comic singing to secure their presence are not very much use, from the gas company's point of view, when they do come. On the other hand, the tone of the whole thing is lowered, and the select portion of the public, which are especially the class that gas companies wish to attract, are kept away.

Experiences may differ, but the writer has heard of excellent results being secured by a first-class practical lecturer, without the aid of any additional attraction. Given a competent lady on the platform, and a well selected and not too extensive show of stoves in the corridor, presided over by a thoroughly qualified salesman from the gas office—if the gas works staff cannot furnish such an individual the sooner the deficiency is remedied the better—and as much will be done in the way of good permanent extension of gas stove business as is possible in any other way. As already suggested, the occasion can be utilized for the extension of any other line of gas apparatus; and if it is worth while to advertise cooking stoves in this way, it is also worth while to give some attention to lighting and heating. In this case the show of goods could be arranged to suit the special lines that are to be pushed. In any case a moderate variety, embracing a few specialities of general utility, is better than an extensive display, which simply dazzles and fatigues the visitor without leading to business. Shows of this sort are easily and cheaply arranged, and a large gas undertaking could do with the exclusive services of a lady demonstrator, who would be continually engaged in giving courses of lessons in various parts of the district, and have certain hours for attending at a central office, in order to be available for consultation by intending users of stoves. In the case of smaller undertakings, it would be possible to share together, or to engage a lady for a few weeks once or twice in each year.

The New York Electrical Exhibition.

According to the *Scientific American*, the exhibition opened on Monday evening, May 2, at the Madison Square Garden, and was crowded with interesting visitors and guests, who listened to the opening address by the Hon. Chauncey M. Depew with eager attention. Mr. Depew spoke of the marvelous development in the industrial applications of electricity, introducing many humorous and patriotic epigrams, and, finally, concluded by stating that he would fire a Spanish gun by a wireless telegraph system, which is one of the latest developments in electrical science. The experiment was successfully done, and out of a Sims pneumatic dynamite gun were shot portions of American and Cuban flags. He then illustrated how the "Maine" was blown up by exploding a miniature bomb in the fountain in the center of the hall, by a direct circuit, which threw up in the air a miniature model of the vessel. But, since the opening night, the bomb is exploded regularly, four or five times a day, indirectly through the wireless telegraph system, and is rather puzzling to those who do not understand it. We have had an opportunity ourselves to make the explosion, which is very effectual and certain. Briefly, the electrical waves passing through the air cause the coherer located near the fountain to close its relay, which puts into operation a local battery circuit, and heats the bomb fuse to redness, when the bomb immediately explodes.

President McKinley, from the White House, at Washington, sent a congratulatory telegram which was read by Mr. Depew, and at 8:47 P.M. the President pressed the key at Washington which opened the exhibition. Vice-President Hobart sent a message by telephone which was recorded on a phonograph cylinder as delivered and then repeated during the evening by the phonograph.

On the main floor of the hall may be seen numerous forms of heavy electrical apparatus, such as large dynamos for electrical railways, pumping outfits, electrical heating apparatus and the practical application of electricity for uses of the household, including automatic electric elevators, electrical cooking utensils, hair curling irons, soldering irons, laundry irons, etc. There is also a novel display of the use of electricity for transportation purposes, such as four different kinds of electric vehicles operated by the storage battery system, on one of which was the placard that it had traveled 3,000 miles.

The bodies of most of the vehicles were capacious and of the piano box plan for the purpose of providing storage room under and beyond the seats for the driving battery, but otherwise their appearance resembled that of an elegant victoria, surrey, trap, cab or a covered drygoods delivery wagon. One noted departure from these expensive styles is a carriage which has three wheels, the single front driving wheel being about 3 feet 6 inches in diameter and carrying a frame on each side for the support of the storage batteries as well as the motor. The pinion of this motor gears into a cog rack near the periphery of the wheel, at which point the power is applied. The promoters claim that thereby there is not so much leverage to overcome as when the power is applied to the axle. The controller and steering handles are hinged to turn one side when the occupant enters or departs from the carriage. The front wheel supporting the batteries presents a very queer appearance, and would, we think, be likely to frighten horses. But, on the score of economy, it is an interesting application of electricity and may become popular.

Near this display of electric carriages is a full sized Stephenson electric street car, running on a track raised 3 feet from the floor and about 50 feet long, showing the complete construction and working of the underground trolley system as now adopted by the New York Metropolitan Street Railway. It is most effective in showing the practical possibilities of this system.

At the east end of the hall is a beautiful model 25-foot electric launch, which has the storage batteries and motor under the floor, and is furnished with six very comfortable chairs and a table. It might be termed a new form of house boat, so handsomely and conveniently is it equipped. Nothing but the steering wheel in the bow indicates that there is any machinery about it.

There is a large exhibit of mammoth storage batteries, now so generally used in electric lighting plants.

In the north basement are three types of gas engine driven dynamos for lighting purposes, which demonstrate their economy over steam and adaptability for local lighting plants. These we shall allude to at some future time.

In one of the upper rooms of the building is arranged a very novel exhibit of the application of Mr. D. McFarland Moore's novel plan of lighting by means of vacuum tubes. He has arranged a room about 20 feet long by 10 feet wide to represent the interior of a small chapel, having an altar and organ at one end and pews on each side of a center aisle. There are eight Gothic arches, each one having electric luminous vacuum tubes formed to fit the curve of the arch, while one long tube made in two parts extends the length of the chapel under the ridge of the supposed roof. The lighting gives one the impression of twilight; it is bright enough to read print by, yet very soft, pleasant and agreeable. This, no doubt, is one of the attractions of the exhibition. In an adjoining room to the chapel is a working model of the third-rail system as applied to steam railroads.

The practical working of wireless telegraphy as at present perfected is one of the curiosities and novelties of the exhibition. In a glass case on one side of the hall is placed a storage battery and the transmitting instrument automatically operated by an electric motor and a switch wheel arranged to make the Morse alphabet signal of N and Y. The induced current from the induction coil is, at these intervals, discharged between the ball terminals, and coincident with the discharges one hears the ringing of an electric gong on the opposite side of the hall, about 300 feet distant. Wires connect each instrument to the earth, but there is no connection through the air. We were informed that preparations are being made to send signals from the tower of the building to a receiver located in Jersey City, about five miles distant, and shall hope to be able to record the success of the experiment.

The New York Telephone Company has a model set of cabinets and exchange installations, while at one side is what is called the "theaterphone," a series of telephones connected to different theaters, by which one can hear the performance by telephone, a transmitter, of course, being located on the stage. The exhibition will remain open afternoon and evening till May 31. It should attract many visitors, as there are many interesting and instructive exhibits.

The Real Meaning of Incandescent Lamp Efficiency.

By Mr. Francis W. Willcox, in *Electrical World*.

An amusing story is told of a lamp purchaser who, when he received a package of lamps and the shipping ticket announcing "50 lamps, 16-candle power, 110 volts, 3.6 watts," carefully examined the package, and wrote to the lamp company: "The lamps have come but the 'watts' mentioned were not in the package."

This happened, of course, in the early days of electric lighting. Hardly any user of lamps to-day does not understand that the term "watts per candle" expresses the economy or efficiency of an incandescent lamp. Almost everyone knows that the term efficiency is used to denote the power per unit of illumination consumed by the lamp at the beginning of its life, and that it is generally convenient and practical to express it in watts per candle. For example, a 16-candle power lamp consuming a total of 50 watts is designated as having an efficiency of 3.1 watts per candle. A 3.1 watt lamp is said to be of higher efficiency than a 3.5-watt lamp, and contrarily a 3.5-watt lamp is of lower efficiency than a 3.1-watt lamp.

This is the generally understood meaning of the term "efficiency," and forms the present accepted basis of rating incandescent lamps. Such a basis of rating is proper and acceptable as a classification of lamps, just as candle power and voltage are. It is not, however, a basis for either rating the value or determining the quality of lamps, as it is quite generally and wrongly understood to be.

In the early days of lamp manufacture the problem was to produce a lamp that would live. Length of life was the first and chief feature sought for, and the aim of lamp manufacturers was the production of a lamp that would consume the least power and yet live. These early lamps consumed 5 and 6 watts per candle, but the art has advanced until a 3.1-watt lamp has finally been developed.

By taking the watt per candle rating only at the start, lamps were after much difficulty produced consuming not to exceed 3.1 watts per candle, and giving a fair average life. The difficulties of lamp manufacture at that time necessitated overlooking what the candle power and resulting watts per candle might be after starting. The production of a lamp that would live and showed an initial efficiency of 3.1 watts was a great achievement and the best the art could then accomplish, but it is necessary to understand just what character of lamp it was. The 3-watt lamp was a 3-watt lamp only temporarily. Like a shooting star, it appeared but for a short time at the high point of its orbit, and immediately thereafter fell rapidly down the scale of candle power and watts per candle to join company with its 5 and 6-watt progenitors.

Such lamps give a low average light during their life, but they were hailed with great acclaim for the saving in power per lamp unit effected. In this way efficiency at starting, or initial efficiency, came to be accepted as a basis for determining the relative value of different lamps, the lamp having the highest efficiency (least watts per candle) with fair average life being judged the best lamp.

With the increased knowledge and ability which time and experience have brought the component lamp manufacturer is no longer troubled by questions of life, and can turn his attention to the more important feature of sustained candle power. The aim is now to produce a lamp which will maintain the best average rating in candle power and watts, and it is on this line that the improvements in lamps in recent years have chiefly been made. These improvements have brought a change from the old point of view which judged lamps by life and initial consumption of watts, and have caused the adoption of a rational and adequate system of determining value—the average candle power and efficiency as given by a lamp during a fixed period of life.

Were the efficiency of an incandescent lamp, like that of a motor or a dynamo, a constant quantity, practically unchanged by duration of service, the initial efficiency rating would for a given voltage and candle power of lamp be a proper measure of its value. Such, however, is not the case, since as a result of the loss of candle power while in service a lamp's efficiency changes considerably, the watts per candle augmenting as a rule in direct proportion to the loss of candle power. The average efficiency, therefore, differs markedly from the initial or starting efficiency. A proper measure of lamp value should consider not only the lamp performance at starting, but its after performance as well, for a given period of life. Average efficiency conforms to this requirement and becomes, therefore, the proper measure of lamp value and test of lamp quality. A reference to the right hand diagram of Fig. 1 will make these points clearer.

Here are illustrated the candle power curves of four lamps, representing various American makes. These lamps are all between 115 and 120 volts, and were each and all tested at the exact initial efficiency of 3.1 watts per candle. They were all burned for 600 hours under constant voltage and the candle power readings taken of each, at 75 to 100-hour intervals, were plotted and the curves shown in the diagram drawn therefrom.

Each of the lamps declines in candle power as the curves show; lamp

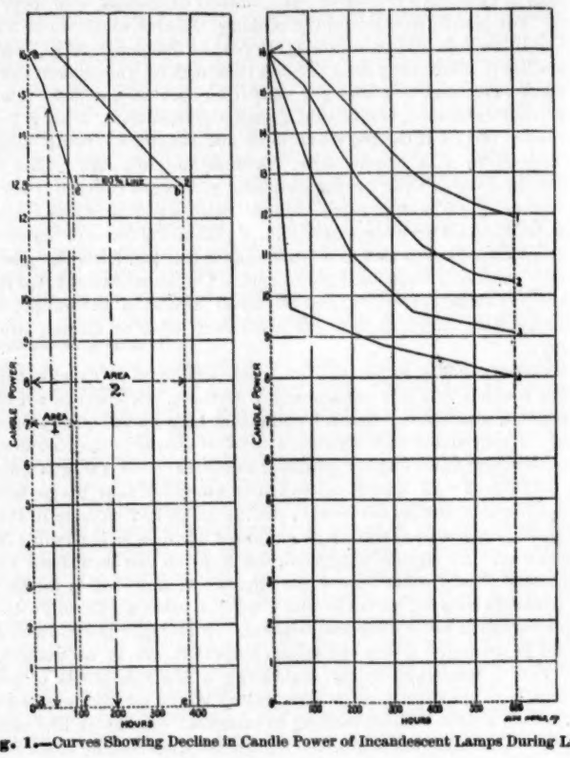


Fig. 1.—Curves Showing Decline in Candle Power of Incandescent Lamps During Life.

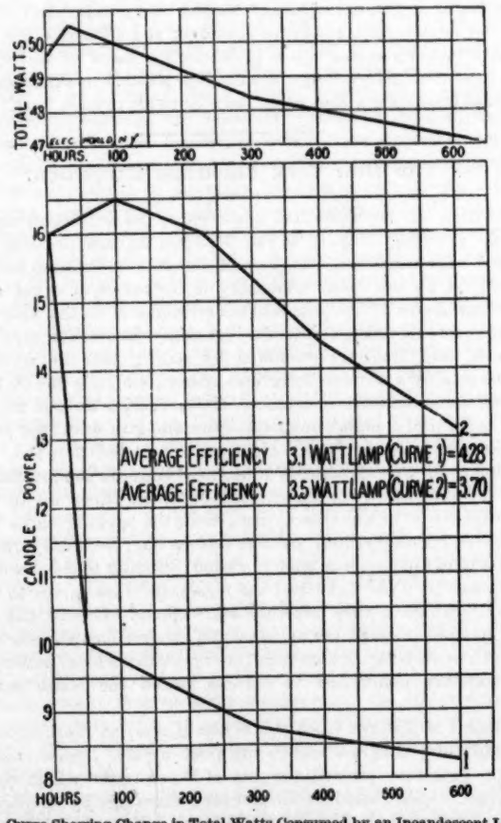

TOTAL WATTS
HOURS
AVERAGE EFFICIENCY 3.1 WATT LAMP (CURVE 1) = 4.28
AVERAGE EFFICIENCY 3.5 WATT LAMP (CURVE 2) = 3.70
CANDLE POWER
HOURS

Fig. 2.—Curve Showing Change in Total Watts Consumed by an Incandescent Lamp During Life.

Fig. 3.—Candle Power Curves of a Poor 3.1-Watt Lamp (No. 1) and a Good 3.5-Watt Lamp (No. 2), Showing the Higher Average Efficiency of the Latter.

No. 1 to 12 candle power at 600 hours; lamp No. 2 to 10½ candle power, and so on to lamp No. 4, which only gives 8 candle power at 600 hours.

If now the total watts taken by each of these lamps diminished in the same proportion as their candle power, the efficiency in watts per candle would remain constant and the average efficiency would be identical with the initial efficiency of each.

The total watts consumed by a lamp during its life under uniform voltage remain practically constant, however. In Fig. 2 is shown the curve of total watts consumption of lamp No. 1 taken out to 600 hours. From this it is seen that the watts consumed decline but slightly, averaging about 5 per cent.

As the candle power declines 25 per cent. in case of lamp No. 1 and 50 per cent. in case of lamp No. 4, the efficiency (or ratio of candle power and watts consumed) changes considerably. The following table gives the average and final efficiency of each lamp:

Lamp.	Initial.	Average.	Final.
No. 1.....	3.1	3.45	3.80
No. 2.....	3.1	3.70	4.35
No. 3.....	3.1	3.83	4.57
No. 4.....	3.1	4.28	5.46

That initial rating indicates practically nothing of the real quality of a lamp is here clearly shown—here are four lamps that as far as initial efficiency goes are equal and the same, and yet at the end of 600 hours burning lamp No. 1 shows a consumption of 1.66 less watts per candle than lamp No. 4.

The poorest grade of lamp, judged by initial rating, appears as good as the best. The incompetent manufacturer can on this basis claim equal standing with the most experienced. The simple device of making a lamp to consume a fixed wattage outweighs the paramount qualities of sustained candle power and uniform light. Thus have the true qualities of a lamp been obscured, its chief function as a light producer ignored, and the purchaser and lighting public misled.[1]

A station manager might as well determine the volume and value of his business by the peak of his load as to attempt to fix lamp quality by initial efficiency. The insufficiency of the initial rating is still more emphatically shown in the fact that of two lamps of different initial efficiencies the lamp consuming the greater watts per candle at starting will frequently consume less watts on the average. A good 3.5 watt lamp will show inside of 200 hours a better average efficiency than a poor 3-watt lamp. This is shown in the diagram given in Fig. 3.

The initial efficiency of a lamp can never form a correct basis of judging its quality or value. It is time that lamp users should understand the term and be made to know that it is at most simply a specification for the lamp similarly to its candle power and voltage.

In ordering lamps, the customer specifies the initial efficiency desired, as he does the voltage and candle power. He may obtain a 3.1-watt lamp or a 4-watt lamp, just as he wishes. There is no virtue in the mere isolated fact of one lamp taking 3 watts to the candle while another takes 4 watts—no more virtue than that one lamp should give 32-candle power as against another's 16-candle power. By changing the candle power through increase or decrease of voltage the initial efficiency can be changed within limits to any desired figure.

The table at head of next column shows the change in candle power and initial efficiency that can be produced through change in voltage.

This lowering and raising of pressure causes the temperature of the lamp filament to change, emitting a lower or higher candle power, and as the power consumed changes in much less degree than the candle power, the ratio of the two, *i. e.*, the watts per candle or efficiency, is made to change.

From the foregoing it is evident that initial efficiency really is only a classification for lamps and not a measure of their value, and that its use for the latter is incorrect and misleading. The real measure of lamp value is the average efficiency, which includes not only the starting conditions but the conditions of performance in a given period of life as well.

Variation in Candle Power and Efficiency of Standard 3.1 Watts per Candle Lamps Due to Variation from Normal Voltage.

Percentage of Normal Voltage of 3.1 Watt Lamps.	Percentage of Normal Candle Power.	Efficiency, or Watts per Candle.
90	53	4.68
91	57	4.46
92	61	4.26
93	65	4.1
94	69½	3.92
95	74	3.76
96	79	3.6
97	84	3.45
98	89	3.34
99	94½	3.22
100	100	3.1
101	106	2.99
102	112	2.9
103	118	2.8
104	124½	2.7
105	131½	2.62
106	138½	2.54

The correct determination of both initial and average efficiency is directly dependent upon the candle power. If the candle power be overrated the efficiency will be also. Photometer measurements of candle power are on this account even more necessary than wattmeter measurement of power consumed.

The candle power of a lamp is, however, the one quantity which the average purchaser is not equipped for determining. The possibility of deceiving him in this particular is the incompetent manufacturer's opportunity. With candle power deception unchecked, neither initial nor average efficiency is determinate, and the value of the lamp is unknown and uncertain.

How important, therefore, is it for central stations to supplement their instrument equipment with a good photometer, in order that they may not only know the value of lamps, and thus be able to select the best, but that they may also by their own testing hold the competent manufacturer to his best.

There is no article of supply purchased by lighting stations in which the need of securing the highest quality is more imperative than in incandescent lamps. Quality in incandescent lamps is absolutely essential and paramount to all other considerations, since the lamp determines the value of the commodity for sale—that is, the light.

While there is need of some capable and impartial bureau of lamp testing to act as inspector of lamp purchases for lamp users, such a bureau is difficult to establish, and would be but feebly patronized (even if established) with the present apathy exhibited by central station managers on this subject. What most is needed is aroused interest in and attention to this all-important subject of lamp quality. Nothing in the whole business of electric lighting is more in need of attention, and there is no other branch of the business where care and attention will return more handsome dividends.

When photometers are generally used, and correct determination of quality takes the place of mere initial watt readings, then, and only then, can we expect to see electric lighting companies rendering unto themselves the values that should be theirs, and unto their consumers the returns that are due them.

1. The above clearly shows that the true efficiency of a lamp, *i.e.*, its average efficiency, is directly dependent upon the maintenance of candle power.

In an article on "The Importance of Quality in Incandescent Lamps" (published in the *Electrical World*, December 11, 1897), the writer established that maintenance of candle power was the most important factor in determining the value of a lamp.

Criticism was made that this method of valuing a lamp's quality did not consider efficiency. From the foregoing account it will be seen that maintenance of candle power is the factor which determines the real or average efficiency, and that, therefore, efficiency is necessarily considered. The initial efficiency is made equal for all lamps under comparison. The lamp then that maintains its candle power best necessarily gives the best average efficiency.

With equal initial conditions, the maintenance of candle power in a given period of life correctly determines the quality of different makes of lamps. This measure includes and considers the three chief features of a lamp, its average candle power, its life (since a given period of life is taken) and its average efficiency, which is deduced from the average candle power.

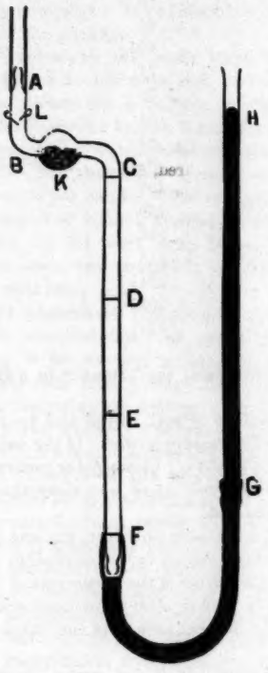
Apparatus for Determining the Composition of Ammonia, Sulphur Dioxide, Water, Etc.

Mr. G. George, F.I.C., etc., writing in *Chemical News*, says that Messrs. Baird & Tatlock, of London and Glasgow, are supplying the apparatus herewith illustrated, which the author declares has been found exceedingly useful for lecture experiments in determining the composition (completely or in part) of a number of gases.

It consists of a bent glass tube *A F*, connected by means of a piece of thick-walled rubber tubing to the glass pressure tube *G H*. The tube *A F* is made of Jena glass of about ¼ inch bore. The lengths of the limbs of the tube are as follows: *A B* and *B C* each about 3 inches, and *C F* about 24 inches. A pair of platinum wire electrodes are fused into the tube at *L*, and a small bulb is blown at *K*. Before use, the tube is graduated into four parts; the volumes between *A* and *C*, *C* and *D*, *D* and *E*, and *E* and *F* being equal. Marks are made at the

points *C*, *D*, *E* and *F*, by means of a file or, preferably, by the use of hydrofluoric acid.

Determination of the Composition of Ammonia Gas.—The tube *A F*, having been graduated and thoroughly cleaned and dried, is attached by means of the rubber tubing to the pressure tube *H G*. A



short piece of rubber is also attached at *A;* in all cases the rubber should be wired on to the glass tubes. Clean *dry* mercury is poured into the pressure tube, and the latter is then raised until the whole of the tube *A F* is filled with mercury. When this is the case, a screw clip is placed over the rubber tube at *A; A F* is now ready for filling with *dry* ammonia. Ammonium hydrate is gently heated and the gas passed through two lime towers to dry it. When it is issuing freely, the delivery tube is connected with *A F* by means of the rubber tube at *A*, and the clip opened. On lowering the pressure tube, *A F* is soon filled with the gas, and the clip is then replaced. A short thistle-headed funnel is attached at *A*, and in it is placed some *fine freshly-ignited* cupric oxide. The pressure tube is raised so that the gas in *A F* is under pressure, and the clip then opened. The cupric oxide enters the tube, and at the same time some of the ammonia escapes. This prevents any air from entering the tube when the copper oxide is being admitted. Ammonia is allowed to escape until *A D* is just filled with the gas at atmospheric pressure. By gently tapping the tube, the copper oxide can be made to occupy the bulb *K*, as shown in the sketch.

The electrodes at *L* are now connected with a powerful induction coil, and sparks passed. After some time the volume of the gas will almost have been doubled; and when allowed to cool, and the pressure adjusted, the gas will occupy *A F* (nearly). The bulb *K* is now heated, first gently and finally to redness. The copper oxide is reduced by the hydrogen, and when all action is over and the apparatus has been allowed to cool down, the residual gas (nitrogen) will be found to occupy *A C;* that is, two volumes of ammonia gas are composed of three volumes of hydrogen and one volume of nitrogen.

To show that *sulphur dioxide* contains its own volume of oxygen, the tube *A F* is filled with dry oxygen, and pure sulphur is then admitted. The oxygen is allowed to escape until *A D* only is occupied by the gas. The portions of tube *A B* and *C D* are then heated by means of the Bunsen, and finally the bulb *K*, which contains the sulphur. When the sulphur takes fire, the flames spread in both directions, and all the oxygen is converted into sulphur dioxide. On allowing the tube to cool and adjusting the pressure, the original volume is found to be unchanged. Therefore sulphur dioxide contains its own volume of oxygen. On allowing a strong solution of potassium bichromate to enter at *A*, all the gas is absorbed.

To prove that *water* contains two volumes of hydrogen and one volume of oxygen, fill *A D* with oxygen and then pass in hydrogen until *A F* is full; that is, there will be two volumes of hydrogen and two volumes of oxygen in the tube. Clamp firmly and spark. On adjusting the pressure, *A C* will be full of oxygen.

The experiment can then be repeated using one volume of oxygen and three volumes of hydrogen.

The apparatus can also be used for showing that nitrous oxide contains its own volume of nitrogen, whilst nitric oxide contains half its volume of nitrogen. In each case potassium is used to decompose the gas. By using dry air and phosphorus, it can be shown that air consists of a mixture of four volumes of nitrogen to every one volume of oxygen.

The Weeks Spraying Device for Carbureters.

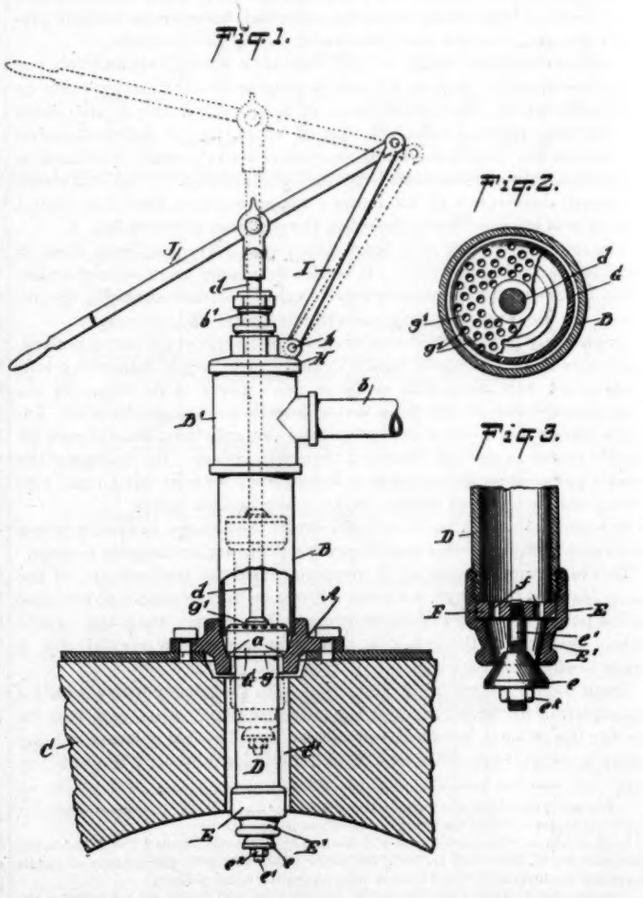
On May 10th U. S. Letters Patent (No. 603,993) were granted to Mr. George H. Weeks, of New York, for a new and improved spraying device for carbureters. Using the words of the specification:

The invention relates to an improvement in spraying devices for carbureters and similar apparatuses, and has for its object to enable the nozzle to be withdrawn from the heated chamber when not actually in use, and thus to prolong the life of the nozzle.

Reference is to be had to the accompanying drawings, forming a part of this specification, in which similar characters of reference indicate corresponding parts in all the figures.

Figure 1 is a longitudinal view, partly in section, of the nozzle and the devices for operating it. Fig. 2 is a cross section taken just outside the inner end of the movable cylinder, and Fig. 3 is a longitudinal section of the inner end of said cylinder and the head of the nozzle.

In using spraying nozzles for the introduction of oil and hydrocarbons as fuel it is often the case, where they are left constantly exposed



to the heat and are only part of the time in use, as is the case in connection with carbureters used for the manufacture of gas, that the nozzle will quickly be burned out, necessitating much delay and inconvenience due to the time lost in removing the nozzle and expense incurred by replacing the same. In my device most of this is obviated and a nozzle will last many times longer than when constructed in the usual manner.

In the drawings, *C* represents one of the walls of the carbureter and has an opening C^1 therein, through which the nozzle is inserted. To the outside of the carbureter is attached a plate *A*, having a central hole therein to receive the nozzle and formed at *a* as a valve seat, upon which a conical surface of the cylinder carrying the nozzle may be forced, so as to close the same.

To the plate *A* is attached a casing *B*, which preferably consists of a short section of pipe which is screwed into a boss formed upon the outer surface of the plate *A*. To the outer end of the casing *B* is attached a T, B^1, which at its outer end is provided with a cap *H*, having a stuffing box or gland b^1 mounted thereon and adapted to receive a rod *d*, by which the cylinder *D* is operated. To the other opening in the T is attached the oil supply pipe *b*.

Within the casing *B* is placed a movable cylinder *D*, which consists of a piece of pipe having upon its outer end a cap *G*, which has its end provided with holes g^1, through which the oil may flow from the casing *B* to the interior of the cylinder or pipe *D*. The inner edge of the cap *G* is turned to form a valve *g*, which is adapted to engage the valve seat *a*, so as to prevent flow of the oil around the cylinder *D*. To the other or inner end of the cylinder *D* is attached a cap *E*, which forms the head of the nozzle. This cap is threaded upon the cylinder *D* and is provided with a ledge adapted to receive a disk *F*, which forms a partition and which is engaged by the end of the cylinder *D* to hold the same in place. This disk is provided with holes *f* to permit the flow of the oil.

To the center of the disk *F* is attached a stem e^1, which projects through the orifice in the cap *E*. The outer end E^1 of this cap is preferably of a conical shape, with the small end outward.

Upon the outer end of the stem e^1 is screwed a cone *e*, which is held in any position by means of the locknut e^2. The small end of this cone enters the discharge orifice in the head *E*. This cone may be adjusted upon the stem, so as to regulate the size of the opening through which the oil flows.

To the cap *G*, fixed upon the inner end of the cylinder *D*, is attached the rod *d*, which extends outward through the stuffing box b^1. Outside the casing this rod is pivoted to a lever *J*, which lever is fulcrumed upon a link *I*, pivoted at *h* to the cap *H*. By means of this lever the cylinder carrying a nozzle may be withdrawn within the casing, as shown by dotted lines in Fig. 1, so as to remove the nozzle from the direct action of the heat within the carbureter, or may be inserted within the carbureter, as shown in full lines in said figure.

When it is desired to spray oil within the carbureter, the nozzle is inserted therein; but as soon as the spraying is discontinued the nozzle is withdrawn by simply raising the lever *J*. As such devices are used in connection with carbureters in manufacturing gas the nozzle is in use only a small part of the time. In consequence of this the nozzles are very rapidly burned out and have to be replaced. This, aside from the cost of the nozzles, incurs considerable expense due to the time lost in replacing the nozzles. With the nozzles constructed as herein shown and described their lives will be very much prolonged, and considerable saving will result from the smaller number of nozzles consumed and the time saved in replacing the same.

The outer casing *B* and the cylinder *D* form telescopic members. The cap *G*, or the cylinder itself, may be made to fit closely within the outer casing *B*, instead of having the identical construction shown. By such construction the contact of the outer surface of the inner member against the inner surface of the outer would form a valve preventing the flow of the oil outside the inner member. Such construction is, however, not deemed as good as the one shown by reason of the fact that it would call for larger finished surfaces, which would add to the cost of construction, while the construction shown in the drawings answers all purposes.

In a small sized apparatus the plate *A* may be made as a screw plug having the proper valve seat and screwing into a threaded opening in the casing.

The inventor submits the following claims:

1. An oil spraying device for carbureters, comprising a casing fixed to the carbureter and having a supply pipe connected thereto, a nozzle within said casing, and means for entering said nozzle within the carbureter or withdrawing it within the casing, at will, substantially as described.

2. An oil spraying device for carbureters, comprising a casing fixed to the carbureter and having a supply pipe connected thereto, a hollow cylinder within said casing and adapted to close the same, a nozzle upon the inner end of said cylinder, and means for reciprocating said cylinder within the casing, at will, substantially as described.

3. An oil-spraying device for carbureters, comprising a casing fixed to the carbureter and having an outwardly facing valve seat within the same, and an oil supply connection, a hollow cylinder within said casing, having a nozzle upon its inner end, and a head or projecting ring upon its outer end having a valve surface adapted to engage the said valve seat, and means for reciprocating the cylinder to seat the valve and project the nozzle into the carbureter or to withdraw the cylinder into the casing, at will, substantially as described.

4. An oil spraying device for carbureters, comprising a casing fixed to the carbureter and having a supply pipe connected thereto, a hollow cylinder within the said casing adapted to close the same, a nozzle upon the inner end of said cylinder, a rod attached to the cylinder and extending outside the casing, and a lever pivoted to said rod and by which the cylinder nozzle may be entered within the carbureter or be withdrawn into the casing, as desired, substantially as described.

5. An oil spraying device for carbureters and similar devices, comprising a telescopic casing, the outer section thereof being secured to the carbureter and the inner section having a nozzle attached thereto, and means for projecting the inner section from the outer section or withdrawing it within the same at will, substantially as described.

6. An oil spraying device for carbureters, comprising a casing fixed to the carbureter and having an outward facing valve within the same, and an oil supply connection, a hollow cylinder within said casing, having a nozzle upon its inner end and a perforated cap upon its outer end, the inner edge of said cap forming a valve to engage the seat, a rod attached to said cap, a stuffing box for the exit of said rod, and means for engaging said rod and moving the cylinder, to project the cylinder into the carbureter or withdraw it into the casing, substantially as described.

7. A nozzle for carbureters, comprising two telescopic members, a hollow cap secured to the end of one member, a perforated disk or partition extending across the cap, a stem supported from said disk, and a cone upon said stem and entering the hole in the cap, substantially as described.

8. An oil spraying device for carbureters, comprising a casing fixed to the carbureter and having a supply pipe connected thereto, a hollow cylinder within this casing adapted to close the inner end thereof, a nozzle upon the inner end of said cylinder, a rod attached to the cylinder and extending outside the casing, a lever pivoted to the outer end of said rod, and a link pivoted to said lever as a fulcrum, whereby the cylinder and nozzle may be entered within the carbureter or withdrawn into the casing, substantially as described.

Fatigue of Metal in Wrought Iron and Steel Forgings.

Mr. H. F. J. Porter, in a paper read by him some time ago before the Franklin Institute, Philadelphia, referred to the prejudice formerly existing in favor of wrought iron forgings and against steel, which is only now passing away. This was due chiefly to the conditions existing at the time when steel forgings were introduced; pieces of large size were not often needed and the hammers in use were small; and the consequence was that when large forgings were required they were not sufficiently worked. Large shafts, for instance, were worked only on the outside, the center being practically untouched. As better facilities for working have been provided, the superior qualities of steel have become evident.

Many failures of forgings in the past, which were the direct results of improper manipulation in manufacture, have been attributed by the uninformed to the "crystallizing effect of shock" or to "fatigue of metal from alternating stresses" in service, particularly when the failure occurred in such forgings as steam hammer rods or to connecting and piston rods and crank pins.

Since this time, however, we have learned more about both iron and steel than was then known, and although our knowledge of the subject of fatigue of metal from the effect of alternating stresses is still limited, we do know that these metals, being initially crystalline, do not become so from shock or other similar service when cold. We have also so far advanced in our methods of manufacture that we are now able to make forgings entirely free from the defects above noted, and which, if properly designed, will, when subjected to service of the character mentioned, last a very long time.

What is this "fatigue of metal" of which we have heard and still hear so much? What is this mysterious cause to which so many failures in the past have been indiscriminately charged? Let us see what investigations into the subject have been made and what has been learned from them.

We find that, as far back as 1871, experiments were reported by Wöhler, in Germany, followed by Spangenberg and Martens and

Bauschinger. In England the subject was similarly reported upon in 1886 by Sir Benj. Baker in his records of tests of material for the Forth Bridge, and it has since been pursued systematically in this country by Mr. James E. Howard, at the Government Testing Bureau, at Watertown. We find that iron and steel are more amenable to the laws of the universe than we had previously given them credit for. That frequent repetitions of load in amount far below the ultimate strength of the material will eventually break down its resistance and cause failure.

Generally speaking we now know that for any given stress a certain number of repetitions produce failure, the greater the intensity of stress the smaller the number of repetitions. We know also that the stress required to cause failure is less, and roughly speaking only half as great when the metal is strained alternately in opposite directions, as where it is strained in one direction only.

Let us, for instance, submit a bar of steel or iron to 30,000 pounds per square inch tensile, or to 30,000 pounds per square inch compressive. In either case the "range" is the same—30,000 pounds. Now let us subject the bar to 15,000 pounds per square inch tensile and to 15,000 pounds per square inch compressive stress alternately, and, although the range is 30,000 pounds as before, the life of the material thus strained will be only half as long, although neither the tensile nor compressive stress approaches the elastic limit of the metal as closely as in the first two cases.

It is in fact very striking how regularly progressive the increase in the number of repetitions is as the range of stress decreases. In other words, the less the metal is maltreated, the longer it will endure, and, if we can make the range of stress small enough, a practically unlimited number of repetitions is required to cause failure. In endurance tests of this character, Wöhler found that the rupture of a bar of wrought iron by tension was caused by any of the following ways :

By	1	application of	55,000	pounds	per	square inch.
"	800	applications of	51,500	"	"	"
"	107,000	"	47,000	"	"	"
"	341,000	"	42,500	"	"	"
"	481,000	"	38,000	"	"	"

A piece of spring steel, subjected to bending, broke as follows :

Under	81,000	applications of	95,000	pounds	per	square inch.
"	154,000	"	85,000	"	"	"
"	210,000	"	75,000	"	"	"
"	472,000	"	65,000	"	"	"
"	539,000	"	58,000	"	"	"
"	1,165,000	"	53,000	"	"	"

The apparatus used to make tests of this character consists of an ordinary lathe bed fitted at the driving spindle with a ball and socket chuck. A babbited box mounted on trunnions is fitted to the other end of the bed. One end of the bar to be tested is screwed into a ball, which is pressed against the face of the chuck by a helical spring ; the other end rests in a box. A loose bronze flanged ring ½-inch wide fits on the bar at its middle. A weighted lever rests on this ring through friction wheels. The ratio of the arms to the lever is as 3 to 1. The fiber stress on the bar can be regulated by varying the weight suspended at the end of the lever. By rotating the weighted bar through the driving spindle of the lathe every fiber is subjected to bending alternately in opposite directions.

Thus conditions are imposed on the metal imitating those which occur in actual practice in such machine parts as railway axles, engine shafts, crank and crosshead pins, etc , where the fibers of the metal are subjected to stresses, continually varying from tension to compression.

The tests of Wöhler, supplemented as above described, show that the material, after a certain number of repetitions of stress, breaks with a fewer subsequent repetitions. It is impossible not to conclude, whatever the cause of decreased life of the bar may be, it is a cause which acts continuously, altering in some way its structure or properties.

It would naturally appear likely that any gradually progressive alteration or fatigue of the bar would be manifested in some way in alteration of the ultimate strength, elastic limit or elongation of the bar, when tested in the ordinary way. This, however, does not appear to be the case. A bar subjected to so many repetitions of loading that it is known to be on the point of breaking, or a piece of bar already broken in an endurance test, gives in the ordinary testing machine no indications that its strength or ductility has been altered.

Specimens taken from the center of the bar, where the treatment has been more severe, show a higher tensile strength than those taken from the ends. This fact has led Mr. Howard, of the Watertown Arsenal, to suggest that possibly the effect of this treatment is similar to cold working the metal : that ordinary, hot worked metal is not left in its state of greatest tensile resistance, and that while repeated alternate stresses below the ordinary accepted tensile strength eventually cause rupture, the metal in an intermediate stage passes through a state of increased resistance. He thinks we are not certain, when final rupture occurs, that the parts first to yield are not at the time in a state of maximum resistance, and the apparent loss in strength may be due to the accumulation of internal strains. Such speculations are extremely interesting and may lead to results that will be valuable. For the present purpose, however, we must confine ourselves to known facts. One of the principal of these is that the fracture of these bars is not crystalline. Usually one half of the specimen seems to have yielded first, and the metal there has the appearance of having worked upon itself, and has a dull laden color ; the other part has a fine granular structure.

The concurrence of evidence from bars broken by fatigue, both in actual service and in the testing machine, is to the effect that there never has been a case found where it was known or could be demonstrated that any change in structure had taken place. And this goes to prove that materials of this kind are incapable of cold crystallization when exposed to the conditions of service mentioned. Careful consideration of the results of endurance tests so far made leads to the recommendation of material for forgings which shall have a very high elastic limit and be so proportioned, if they are to be subjected to frequently alternating stresses, that these stresses shall at all times lie far within this limit. In order to insure these two points, steel, not wrought iron, should be the metal used, and the higher the carbon content of the steel the longer will be its life, other things being equal.

High carbon steel forgings, sound and free from internal strains, are by no means easy to produce. Much time and thought have been expended to devise methods for making them, and much money has been invested in fitting up the necessary apparatus. In order to have thorough supervision and control of every process, complete chemical and physical laboratories should be adjuncts of every forge that expects to do conscientious work. Records should be kept of the treatment of each forging as it progresses from one stage to another.

In order that the metal of a forging should be thoroughly worked, to give it strength and toughness, the ingot should be cast approximately twice its diameter. Besides this increase in diameter there is added from 10 to 25 per cent. to its length.

There are various defects which are inherent in steel ingots. In the first place, when pouring metal into the mold air is apt to be entrained and cause blowholes. In the next place, at certain stages of the cooling process gas is generated, and will cause blowholes of itself. There are several ways of overcoming these defects, but without doubt the most efficient is what is known as the Whitworth process of fluid compression. In this the mold is placed on a platen and is run underneath a hydraulic press. This press has a capacity of over 7,000 tons, and under this enormous pressure the air which has been entrained in the pouring is forced out through the joints in the mold, where vents have been left for that purpose, and the gases which are apt to form in the cooling of the mass are prevented from generating.

Another defect which is apt to occur in an ingot is known technically as piping. The metal when it is poured into a mold, cools and solidifies first at the surface of the mold, and as the solid metal keeps cooling towards the center, it shrinks and draws away from it. We have, if you can imagine such a thing, a pot with metal in it which is really not sufficient to fill it properly, but which is being drawn out in all directions to fill it. The shrinkage draws principally from the center and from the top, these being the parts that solidify last. It is, therefore, to take care of this shrinkage that more metal is added to the length of the ingot than would otherwise be required. The hydraulic pressure applied at the top forces the fluid metal from this added part down through the center, and thus we are enabled to keep the latter filled, where otherwise we would have a cavity or pipe.

Still another defect which is apt to occur in ingots, and especially in those of very large size, is what is known as segregation. This is partly a mechanical and partly a chemical separation of the various ingredients of steel (sulphur, phosphorus, manganese, silicon, etc.), each of which has its own temperature of cooling. As the mass cools the tendency of these ingredients is towards the central and upper portions, where it cools last, thus forming a central core of impurities. This does not occur to such a great extent in small ingots, but in all large ingots it does occur, and even this process of fluid compression does not entirely prevent it.

In the foregoing process proper one of the first requisites is the proper selection of forging tools. The pressure applied in shaping a piece of

steel should be sufficient in amount and of such a character as to penetrate to the center and cause flowing throughout the mass. This flowing of the metal requires a certain amount of time, and the requisite pressure should be maintained throughout a corresponding period. The hydraulic press fills these requirements exactly. Under the slow motion of the press time is allowed for the molecules of the metal to move easily and the pressure is felt all through the forging. During the forging process, in which there is a gradual reduction in diameter and increase in length, a great deal of work is put into the metal. In order that the metal should be worked at the proper temperature it is necessary to reheat it a number of times, and every time a blow is made by the press the metal is worked under conditions differing from those existing when the preceding blow was made, because it has cooled a little in the interval. As, therefore, when finished, no two parts of the forging have been treated the same, it is natural to suppose that it is full of forging strains. It is also apt to have cooling strains in it, due to the fact that it has been reheated from time to time in different places as the forging process passes from one end of the piece to the other. To relieve these various strains, all forgings should be subjected to a final heat treatment, called annealing.

The use of hollow shafts of proper design and of higher carbon steel is treated at considerable length in the paper, and many illustrations are given. The importance of annealing is especially urged. The conclusions reached are substantially as follows:

In general, it can be stated that experience shows that where high duty is demanded of a forging, mild steel of a tensile strength of 60,000 pounds is not the best material to use, owing to its low elastic limit. The tendency is now towards the adoption of a higher carbon steel, followed by such treatment as will raise the elastic limit relatively to the ultimate strength.

Specifications for the forgings of an engine should require that they shall be made of open hearth steel and that they shall be carefully annealed after forging.

Large shafts and similar forgings, crank and crosshead pins, should be made of fluid-compressed steel, and should be hydraulic forged, not hammered. Wherever practicable, an axial hole should be bored through shafts to insure absence of any internal defects. If forgings are oil tempered, the hole can be made larger in diameter than if they are simply annealed, and where the hole is 7 inches in diameter and above they can be hollow forged on a mandrel. A hollow forged, oil tempered forging insures the highest attainable qualities. Where it is important that the quality specified should be obtained in the more important parts, physical tests of the forgings as delivered should be demanded.

The causes of failure in forgings are in general to be found either in their design, quality of material or character of treatment in manufacture. Almost all forgings are subjected to alternating stresses. If they are composed of a quality of material which has a high elastic limit, properly proportioned, so that the stresses applied fall well below this limit, and if then they are free from flaws, defects and initial stresses, they should resist fatigue indefinitely.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. James Parish, Jr., has been formally appointed to the position of Manager of the Tonawanda (N. Y.) Gas Light Company.

The syndicate that recently acquired the plant and franchises of the Charlottetown (Prince Edward Island) Gas Light Company has reincorporated the property under the specific title of the Charlottetown Light and Power Company, Limited. The capital at present is $150,000, but the Company has the right to increase it to $250,000, and it also has the right to issue bonds to the full extent of the capital. The Company's new charter permits it to construct and operate a street railway system, by which it is proposed to connect Charlottetown with two or three flourishing suburban districts. The Company has the right to operate the road by means of compressed gas, compressed air, electricity, or steam, as it eventually may elect. At the present time it looks that gas will be selected, the equipment to be similar to that employed on the tramway system of Blackpool, England, or Dessau, Germany. The Company's Engineer, Mr. Henry R. Lordly (who is a graduate of Cornell University), has been commissioned to visit the named places to inspect the gas tramway system before the same is finally determined upon for Charlottetown.

The annual meeting of the Glens Falls (N. Y.) Gas Light Company was well attended, and important action respecting the Company's physical condition was taken. The Directors chosen were: Addison B. Colvin, F. A. Sabbaton, F. F. Pruyn, Richard P. Merrifield and Howard A. Brooke; President, Addison B. Colvin—by the way, Mr. Colvin is State Treasurer of New York; Vice-President, Richard P. Merrifield; Secretary, Treasurer and Superintendent, F. A. Sabbaton. It was decided to expend about $12,000 in improving and enlarging the plant and in extending the main system. President Colvin, Director Pruyn and the Superintendent were appointed a Committee with full power to plan and complete the improvements. The Glens Falls Trust Company was designated Trustee of the new bonds which the Company proposes to issue. The financial showing for the year was an excellent one.

Mr. John Curley, for some time in the service of the Richmond County Gas Light Company, of Stapleton, Borough of Richmond, N.Y., died on the morning of the 15th inst. Deceased was in his 38th year.

Mr. Henry Hopkins, Superintendent of Street Lighting, New Haven, Conn., in his report to the authorities concerning the operations of his department for the past year, submits some interesting figures. Referring to the effect of high wind on street lights, a table prepared by Superintendent Hopkins discloses the fact that during one night, when the wind blew at the rate of 11 to 40 miles an hour, 1 Welsbach lamp, 8 ordinary gas lamp burners and 77 naphtha burners were extinguished. None of the 442 electric lamps was affected. During the time of the "blow" 105 Welsbachs, 633 ordinary gas burners and 512 naphtha burners were in use.

The amended license ordinances of San Jose, Cal., provide, among other things, that "each person, house, firm or company or corporation supplying either water, gas or electricity, to consumers for pay," shall cover into the city treasury "$50 per quarter for each article furnished."

It is said that the Bergen County Gas Light Company, of Englewood, N. J., may not soon extend its mains to the outlying district of Tenafly. The delay is occasioned by the refusal of the Company to permit the borough officials to supervise the work, which demand was made by the official.

The Newark, N.J., *Advertiser* of the 16th inst., published the following: "Newark capitalists interested in electric light enterprise have purchased all the stock of the Montclair (N. J.) Gas and Water Company and the Summit (N. J.) Gas Light Company. The Newark Gas Company is not interested in the deal. The negotiations have been quietly in progress for some time and the agreements which were made three weeks ago have been finally consummated. The transactions on the part of the purchasers were conducted in the name of Philip N. Jackson, President of the Peoples Electric Light Company, of Newark. The Montclair Gas and Water Company is capitalized in $139,500. The stockholders receive 250 per cent. for their stock, or $348,750 altogether. The plant is subject to a mortgage of $25,000. The Summit Gas Light Company's stock is $111,400, and it was sold for 125 per cent., or a total of $139,250. This Company has a gas plant, but it has not been in use, the Company buying its gas from the Newark Gas Company. President Henry C. Kelsey, of the latter Company, when asked what he knew about the deal, said: 'I have had nothing to do with it, and our Company is not interested in any way. The transactions are wholly by other parties, and who they are, besides Mr. Jackson, I am unable to say.'"

The Passaic (N. J.) Lighting Company has petitioned the East Rutherford Council for permission to lay gas mains in East Rutherford.

At the annual meeting of the Bangor (Maine) Gas Light Company the officers chosen were: Directors, T. U. Coe, C. P. Stetson, Willard Cutter, A. C. Hamlin and J. F. Snow; President, T. U. Coe; Clerk, C. M. Griffin; Treasurer, G. A. Crosby; Superintendent, C. E. Dole; Assistant Superintendent, V. K. Gould.

The gas plant of the Oroville (Cal.) Gas, Electric Light and Power Company is to be changed over to the water gas system.

Mr. Jno. R. Lynn, formerly in charge of the works of the Benton Harbor and St. Joseph (Mich.) Gas Company, has been appointed Superintendent of the reorganized Port Huron (Mich.) Company.

City Attorney Gilmore, of New Orleans, La., having been asked if the New Orleans Gas Light Company could not be required to obtain permission from the City Council before tearing up the public streets, has returned his reply to the Council. He incidentally touches the question of the right of the city to require all persons applying for per-

mission to tear up the streets to give sufficient bond to guarantee that the streets will be restored to the satisfaction of the city authorities. Mr. Gilmore, dealing with these matters, says that under Act 97, of 1870, Section 9, the Crescent City Gas Light Company, the franchise of which is now owned by the New Orleans Gas Light Company, was authorized to lay pipes or conduits at the expense of the Company in any of the streets or alleys of the city, where the same might be required, and in such manner as would produce the least inconvenience to the city or its inhabitants; and provided also that the Company should afterwards repair with the least possible delay the streets it had broken. Mr. Gilmore explained that the New Orleans Water Works Company, by Act No. 33, of 1877, Section 5, was authorized to lay and place any number of pipes and conduits, and to repair or cleanse them over any of the streets or land it occupied, provided the same should not be an obstruction to commerce or free circulation. Under and in view of such "legislative grants," the City Attorney advises that he is of the opinion those companies could not be compelled to apply for permission prior to the laying of mains or pipes. He is also of the opinion that no bond for the repair of streets could be exacted. The city would have the right to require that the work of tearing up, laying the pipes and repairing the streets should be subject to sanitary or police regulations, provided by ordinances. Under the ordinance No. 3,171, Dec. 23, 1855; ordinance No. 5,569, April 11, 1869, and ordinance No. 7,829, August, 1881, penalties were provided for any failure on the part of the Gas or Water Companies to relay the streets or banquettes, whenever repairing or relaying pipes.

THE Board of Directors of the Pottstown (Pa.) Gas Company recently perfected the following executive organization: President, Dr. J. E. Porter; Treasurer, Willlam H. Smith; Secretary, J. S. Baker.

MR. J. H. BLEDSOE, the efficient and popular Superintendent of the Winnepesaukee Gas and Electric Company, of Laconia, N. H., is much gratified over the success that has attended his efforts to popularize the use of gas for cooking in Laconia. Several prepayment meters have been placed, and the likelihood is that many more will go into service.

THE city authorities of Duluth, Minn., have stopped the Prindle Gas Company from going on with its main laying. The Mayor and the Board of Public Works, in support of their decree, insist that the Company may not go ahead, since a city ordinance prohibits "the construction or maintenance of a gas plant inside the fire limits."

MR. JAMES W. MCCLURE, of the Oakland (Cal.) Gas, Light and Heat Company, has been admitted to the California Bar.

MR. JOHN A. GIBLIN, formerly Manager of the Mohawk and Ilion (N. Y.) Gas Company, has been appointed Manager of the gas and electric properties that are being operated in Herkimer, Little Falls and Ilion and Mohawk by the Central New York Gas and Electric Company.

SOME time ago, in reply to an invitation to tender for the lighting of the public buildings of Dubuque, Iowa, for the current year, the proprietors of the Key City Gas Company agreed to perform the service "for the sum of $648; or, to give the city free gas in exchange for fair play. That is to say, if your Honorable Body will reduce our taxation to that paid by either electric light plant last year, we will light all these buildings absolutely free of charge. We herewith hand you certified check to secure performance of contract under whichever of these proposals you may choose to accept." The proposal to light for $648 per annum was accepted. The electric men bid $900.

THE authorities of Wilkes-Barre, Pa., have authorized the Wilkes-Barre Gas Company to maintain a minimum of 200 public gas lamps for the current year. The rate is $20 per post per annum.

ABOUT a fortnight ago Mr. John H. Cowing, General Manager of the Buffalo (N. Y.) City Gas Company, issued the following notice to consumers residing on streets where the Peoples Company is now supplying gas: "Until further notice the price of gas to your premises will be 50 cents net per 1,000 cubic feet, if paid on or before the 10th of each month. We trust that you will appreciate the fact that this will prevent the annoyance of having your lawns destroyed in putting in other pipe."

MR. MILTON J. PAYNE, President of the Kansas City, Missouri, Gas Company, acting by authority of the Company's management, has increased the Company's subscription to the fund for constructing a convention hall for the festivities to be held in that city next fall. The Company's contribution to the fund now amounts to $2,500.

THE Board of Trade, Brockton, Mass., proposes to petitition the Board of Gas and Electric Light Commissioners for a revision of the gas rates in that city.

ARTICLES incorporating the Electric Gas Regulator Company, of San Francisco, have been filed: The capital stock is $30,000, and the Directors are: C. T. Ryland, W. E. H. Williams, A. P. Seilor, S. C. Denson and W. C. Mahoney.

THE report of the operations of the Gas Inspector of Minneapolis, Minn. (Mr. A. D. Meeds), during the year 1897, contains much that is of interest. Regarding the candle power of the gas supplied, Mr. Meeds remarks that it was generally very satisfactory; the average for the year being 25.15 candles, the ordinance requirement being 23 candles. The lowest monthly average (June) was 23.57 candles; the highest (September) was 29.27 candles. The amount of sulphur content in the gas was usually below the maximum allowed by the law. In a few instances the amount exceeded the limit by less than a grain, but on July 16th the test showed 35.6 grains. The Company was at once notified, and in fair time the quantity was reduced to the normal. This occurrence was explained that, through a mistake of the coal shippers, an invoice of ordinary steam coal was forwarded in place of the gas coal that should have been supplied. There was no excess of ammonia found in the gas; in fact, it was well under the stipulation, the average for the year being 0.68 grain per 100 cubic feet, whereas the ordinance permits a content of 5 grains. Sulphureted hydrogen was discovered several times (58) during the year. Regarding the gas street lighting service the Inspector says: "The gas lighting service on the streets during the year has been very good, and as a consequence very few complaints were made concerning it. During the year 162 gas lights were reported out when they should be burning, which is 100 less than during 1896, and about one-quarter of the number out in 1895. This is a remarkably good showing for this climate. The light inspector has given as much attention to the light as before, and it is presumed that the police have done likewise, so that the showing is not one of neglect on the part of the city employees, and denotes an improved condition of the lights." During the year 1,200 burners from the street lamps were tested, and the average consumption per hour over all was shown to be 6.11 cubic feet per burner. Mr. Meeds says that the trial lamps maintained for some time by the Welsbach Street Lighting Company of America "seemed to give very general satisfaction to the people who saw them. They give a very fine light for the purpose of street illumination, distributing the light very much better than electric lights where the latter are placed only at the corners of the streets. It would be very desirable to introduce this system into the residence portions of the city, if the prices were brought down to a reasonable figure." The number of miles of streets lighted by gas was 82.19; by gasoline, 82.23; by electric arcs, 79.21. Respecting the gas meter inspection division of his department, Mr. Meeds says: "During the year 78 meters were tested in this office, of which 42 were consumers' meters, taken from service on complaint, and 36 were from the Gas Company's repair shop. Of the 78 meters, 30 registered fast, an average of 1.73 per cent.; 24 registered slow, an average of 1.15 per cent.; and 24 registered correctly. The average of the 78 meters was .31 per cent. fast, and the average of the 42 meters from service was .78 per cent. fast. Of the 78 meters tested, 14 (or 17.95 per cent.) were condemned; and of the 42 meters from service, 14 (or 33⅓ per cent.) were condemned. The fees collected for testing meters amounted to $41, of which $8 was refunded on account of the meters registering more than the 2 per cent. fast allowed by law, and the balance of $33 was paid into the city treasury.

THE authorities of Painesville, Ohio, have fixed the rates which the Painesville Gas Light and Coal Company may charge for gas during the 10 years, dating from May 4, 1898: For an illuminating supply, $1.25 per 1,000 cubic feet; for a supply on fuel account, $1 per 1,000. The illuminating quality of the gas may not be less than 16 candles.

THE illumination of the streets of Haverhill, Mass., so far as that is being accomplished by means of Welsbach lamps, is generally commended.

ARTICLES announcing the incorporation of the Los Angeles (Cal.) Gas Company have been filed by Messrs. W. J. Fay, A. C. Bilicke, T. S. C. Lowe, Thad. Lowe and E. W. Pratt. Capital, $1,000,000.

THE AMERICAN GAS LIGHT JOURNAL

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PROPRIETORS.

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MONDAY, MAY 23, 1898.

A New Thermopile.

The radiometer of Crookes, the micro-radiometer of Boys, and the splendid work which Langley has done with his bolometer, have almost made us forget the delicate thermopile of Melloni, which was indispensable on any lecture table twenty years ago. There is one objection to Melloni's pile. Though one cannot call it massive, its heat capacity is heat capacity is sufficiently large that it does not respond with promptitude to rapid minute changes in temperature. With the antimony-bismuth pile no great improvement could be realized, since these metals cannot be drawn out to fine wires. But H. Rubens has obtained excellent results with iron-constantan couples although their electromotive force is only half that of the Melloni's junction, 53 against 100 microvolts per degree Centigrade. The pile is contained in a brass cylinder, provided with two longitudinal slots 180° apart, over which a sleeve, with two slots, 90° apart, is fitted; only one of the slots is therefore open at the time. Inside the cylinder is an ebonite frame with two parallel rows each of 10 pins, between which the wires are stretched in a continuous zigzag line. The distance between the two rows is 10 millimeters, between two pins of the same row 2 millimeters; the wires have a thickness of 0.1 (iron) and 0.15 millimeters (constantan.) The pins serve simply as holders, not as thermo-junctions. Each of the 20 wires consists of halves of the different substances, and there are even junctions in the centers between the row of pins and odd junctions near the pins. The junctions are hammered out to very fine little discs. Special diaphragms allow the heat rays to fall on the even junctions only. The electromotive force of the 20 junctions is 0.00106 volt. With an internal resistance of 3.5 ohms and 5 ohms in the galvanometer, a difference of 1° C. would, in Ruben's pile, give a deflection of 3,600 millimeters, so that the ten-millionth part of 1° C. can easily be estimated. The pile is, therefore, not inferior in sensitiveness to a bolometer, and the advantage over the latter is that the currents are so weak that no disturbance from the heated air round the wires can arise, which may occur in the case of a bolometer. The new thermopile can also be inserted in the eye-piece of a spectrometer. Professor Rubens describes this apparatus in the *Zeitschrift für Instrumentenkunde.*

Gas Cooking at the Astor House.

The Astor House, New York, can boast of being a pioneer among American hotels in the matter of cooking by gas. It discovered some years ago the advantages of the method, which other hotels and restaurants have only come to perceive recently. So when inquirers go to the manager of the Astor House to ask him how he likes his apparatus for cooking by gas his first answer is apt to be a little indignant. Would he have been using it for six years or more if he didn't like it? Then, settling down to something more specific, he will declare that he would not take $1,000 for his combination broiler, or his gas range, if it were not possible to replace them. Everybody knows how large a transient custom the Astor House restaurant has. On days such as the Washington Centennial, or the Grant Monument Day, or when the city is crowded with strangers, the number of chops and steaks broiled and served in the Astor House is almost fabulous. Yet the combination gas broiler in the kitchen is ready to meet all demands, and could broil for a regiment every day if necessary. How much does the gas cost? Well, they refuse to discuss that question at the Astor House. All they look to is the results—perfect cooking, satisfied guests. A few dollars more or less do not count in comparison; but the cost is surprisingly small, all things considered.

The Market for Gas Securities.

The quotations for city gas shares are at much higher prices than those reported a week ago. Consolidated opened to day (Friday) at 196 to 196¼, sold up to 196¼, and reacted to 194½. Mutual is reported at 340 bid, Standards have more than held their own, and the New Amsterdam securities, from common to bonds, scored sharp advances. The outlook is in favor of still better prices.

Brooklyn Union is strong, at 120 to 121, and a like remark applies to the bonds, which are quoted at 113 to 113¼. Bay State is neglected at 2¾ to 3. Baltimore Consolidated is 59¼, ex-dividend of 2½ per cent, which is payable on the 1st prox. Peoples, of Chicago, opened this morning at 98 to 98⅛. Lacledes are stronger as to the preferred and weaker as to the common. The American Gas Company, through its Treasurer (Mr. Morris W. Stroud) announces a dividend of 3 per cent. on its stock, payable the 1st prox. Our item columns contain some matter going to show that gas share values in New Jersey are climbing rapidly, the acceleration in certain instances being traceable undoubtedly to contests for control between important aggressive financial interests.

Gas Stocks.

Quotations by Frederic R. Cochran & Co., Brokers and Dealers in Gas Stocks.

20 AND 22 BROAD STREET, NEW YORK CITY.

MAY 23.

☞ All communications will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$36,230,000	100	196	196¼
Central	500,000	50		..
" Scrip	220,000	..	100	.
Cental Union, Bonds, 5's	3,000,000	1,000	99⅝	100
Equitable	4,000,000	100	206	215
Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	,500,000	100	340	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	32	3⅜
Preferred	10,000,000	100	71	71½
Bonds, 5's	11,000,000	1,000	98	99
Northern	150,000	50		
" Bonds	150,000	1,000	..	
Northern Union, Bonds, 5's	1,250,000	1,000	94½	95½
New York and East River	5,000,000	100	81	88
Preferred	2,000,000	100	112	115
Bonds 1st 5's	3,500,000	1,000	108	111
" 1st Con. 5's	1,500,000	..	104	106
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	
Standard	5,000,000	100	140	142
Preferred	5,000,000	100	155	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	114	115
Yonkers	299,650	50	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	120	121
" " Bonds (5's)	15 000,000	1,000	113	113¼
Bay State	50,000,000	50	2¾	3
" Income Bonds	2,000,000	1,000	..	75
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	..	92
2d " " "	3,000,000	1,000	70	..
Buffalo City Gas Co.	7,000,000	100	27	..
" " Bonds, 5's	7,000,000	1,000	90	92
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus	1,000,000	.	89	91
1st Mortgage	1,085,000	..	101	103½
Consumers, Jersey City	2,000,000	100	75	80
" Bonds	600,000	1,000	102½	105
Cincinnati G. & C. Co.	8,500,000	100	200	201
Consumers, Toronto	1,800,000	50	184½	187
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	..	59¾x
Mortgage, 6's	3,300,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit	4,000,000		48	51
" Con. Bonds	4,312,000	..	..	95
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	.	101
Fort Wayne	2,000,000	..	78	81
" Bonds	2,000,000	..	89	91
Hartford	750,000	25		145
Indianapolis	2,000,000	..	115	125
" Bonds, 6's	2 650,000	..	106	107
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	78	80
Bonds	1,000,000	1,000	90	91
Louisville	2,370,000	50		..
Laclede, St. Louis	7,500,000	100	46¼	46⅝
Preferred	2,500,000	100	91	93
Bonds	9,084,400	1,000	103	..
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	200	220
Bonds, 6's	4,000,000		128	130x
New Haven	1,000,000	25	252	..
Oakland, Cal.	2,000,000	..	53¼	54
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	98	98⅛
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,00	1,000	..	108
2d "	2,500,000	1,000	104	105
Peoples, Jersey City	500,000	50	..	175
Rochester Gas & Elec. Co.	2,150,000	50	..	..
Preferred	2,150,000	50	88	..
Consolidated 5's	2,000,000		87½	90
San Francisco, Cal.	10,000,000	100	94	94¼
St. Paul Gas Light Co.	1,500,000	100	49	51
1st Mortgage 6's	650,000	..	84	87
Extension, 6's	600,000	..	..	..
General Mortgage, 5's	2,400,000	..	88	90
Syracuse, N. Y.	2,500,000	25	17	19
Bonds	1,000 000	.	94	97
Washington, D. C	2,000,000	20	250	
Western, Milwaukee	4,000,000	100	77	78¼
Bonds, 5's	3,556,000	.	102¼	103½
Wilmington, Del.	550,000	50	200	

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Maryland Meter and Mfg. Co., Baltimore, Md	846
Metric Metal Co., Erie, Pa	846
Keystone Meter Co., Royersford, Pa	846
Detroit Meter Company, Detroit, Mich	847

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	847
John J. Griffin & Co., Phila., Pa	848
D. McDonald & Co., Albany, N. Y	845
Helme & McIlhenny, Phila., Pa	847

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Ohio Pipe Co., Columbus, Ohio	845
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R. D. Wood & Co., Phila., Pa	842
Warren Foundry and Machine Co., New York City	845
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Utica Pipe Foundry Co., Utica, N. Y	845

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GAS ENRICHERS.

Standard Oil Co., New York City	837
The Sun Oil Co., Pittsburgh, Pa	837

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C. M. Keller, Columbus, Ind	837

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The Bristol Co., Waterbury, Conn	827

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Connelly Iron Sponge and Governor Co., New York City	835
Isbell-Porter Co., New York City	842
The Wilder Mfg. Co., Phila., Pa	826
R. D. Wood & Co., Phila., Pa	842
Wm. M. Crane & Co., New York City	826

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City	842
Continental Iron Works, Brooklyn, N.Y	842
G. Shepard Page's Sons, New York City	843
Logan Iron Works, Brooklyn, N. Y	844
R. D. Wood & Co., Phila., Pa	842

CEMENTS.

C. L. Gerould & Co., Mount Vernon, N.Y	833

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J	838
B. Kreischer & Sons, New York City	838
Adam Weber, New York City	838
Laclede Firebrick Mfg. Co., St. Louis, Mo	838
Cyrus Borgner, Phila., Pa	838
James Gardner, Jr., Pittsburgh, Pa	838
Henry Maurer & Son, New York City	838
Baltimore Retort and Firebrick Co., Baltimore, Md	838
Parker-Russell Mining and Mfg. Co., St. Louis, Mo	838
Brooklyn Firebrick Works, Brooklyn, N. Y	838
F. Behrend, New York City	827

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Welsbach Commercial Co., Phila., Pa	832
Victor Incandescent Company, New York City	826

MICA GOODS.

The Mica Mfg. Co., New York City	825

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D. M. Steward Mfg. Co., Chattanooga, Tenn	825

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Welsbach Street Lighting Co., New York and Phila	834

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Gas Purification and Chemical Co., Ltd., London	851

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Isbell-Porter Company, New York City	842
Connelly Iron Sponge and Governor Co., New York City	835

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Ludlow Valve Manufacturing Co., Troy, N. Y	830
Chapman Valve Manufacturing Co., Boston, Mass	830
R. D. Wood & Co., Phila., Pa	842
Continental Iron Works, Brooklyn, N. Y	842
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Isbell-Porter Co., New York City	842
The Western Gas Construction Co., Fort Wayne Ind	830

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Wm. Henry White, New York City	843

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Davis & Farnum Mfg. Co., Waltham, Mass	840
Kerr Murray Mfg. Co., Fort Wayne, Ind	840
Stacey Mfg. Co., Cincinnati, Ohio	843
R. D. Wood & Co., Philadelphia, Pa	842
Logan Iron Works, Brooklyn, N. Y	844
Riter-Conley Co., Pittsburgh, Pa	834

DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, May 12, 1898.

The Directors have this day declared a quarterly dividend of two (2) per cent. on the preferred stock, payable June 10, 1898, to stockholders of record at the close of business May 31, 1898. Transfer books of the preferred stock will be closed from June 1 to June 10, 1898, both inclusive. Checks will be mailed

1198-3 EDWARD C. LEE, Treasurer.

DIVIDEND NOTICE.

OFFICE OF THE AMERICAN GAS COMPANY,
222 S. THIRD ST., Phila., Pa., May 18, 1898.

The Board of Directors of The American Gas Company have this day declared a semi-annual dividend of 3 per cent., or $3 per share, on the outstanding Capital Stock of the Company, payable on and after June 1, 1898.

1198-1 MORRIS W. STROUD, Treas.

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1192-6 60 Equitable Building, Boston, Mass.

SUPERINTENDENT.

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1184-tf "F. J.," care this Journal.

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Multitubular Condenser, shell, 36 in. diameter, with 98 2-in. tubes, 10 ft. 6 in. long.

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Scrubber, 48 in. diameter, 11 ft. 9 in. high. Three man holes, 11 in. by 15 in.

8-inch Center Seal. Four Purifiers, 8 ft. x 6 ft.

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OF THE

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is open to accept immediate engagement; charge of works, or on the road. Experience in working inclined retorts. First-class references and testimonials. Address

1178 tf "M. R. S.," care this Journal.

SALE OF GAS and ELECTRIC LIGHT PLANT.

The undersigned, as Receiver, will, on Tuesday, the 31st day of May, A.D. 1898, at the north door of the Court House, in Girard, Crawford County, Kansas, offer for sale to the highest bidder for cash at time of sale, the gas and electric light plants of the Pittsburg Gas Light and Coke Company, of Pittsburg, Kansas, which comprises one-half block in the center of the city, with the improvements and machinery thereon, and the gas and electric light systems of the city of Pittsburg. The Pittsburg Gas Light and Coke Company is a Kansas corporation with a capital stock of $100,000. The property will be sold subject to outstanding bonds in the sum of $52,500, and for not less than sufficient to pay outstanding Receiver's certificates and expenses, and costs, which at the time of sale will approximate $13,000. The gross yearly income from the plants averaged $19,000 for the past two years, and improvements to the amount of $10,000 have been added to the property during that time. The Gas Company has a lighting contract with the city that has yet 10 years to run, that pays about $5,000 per year. Pittsburg, Kansas, in March, 1897, had a population of over 12,000. It has since increased. It is in the center of the coal and zinc region of Southeastern Kansas, and is the most progressive and thrifty city in the State. During the year ending March, 1897, the population increased upward of 2,000. The property is desirable for any one seeking that kind of investment. For further particulars address the undersigned,

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1191-8t Pittsburg, Kansas.

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A Small Gas and Electric Light Plant,

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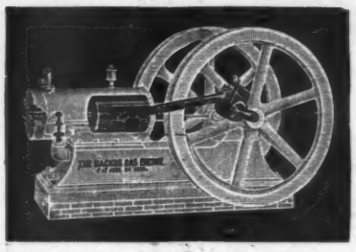

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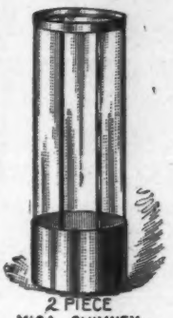

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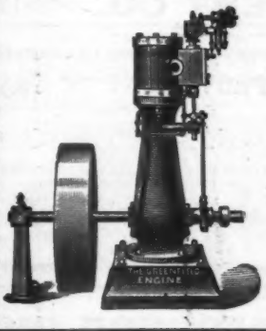

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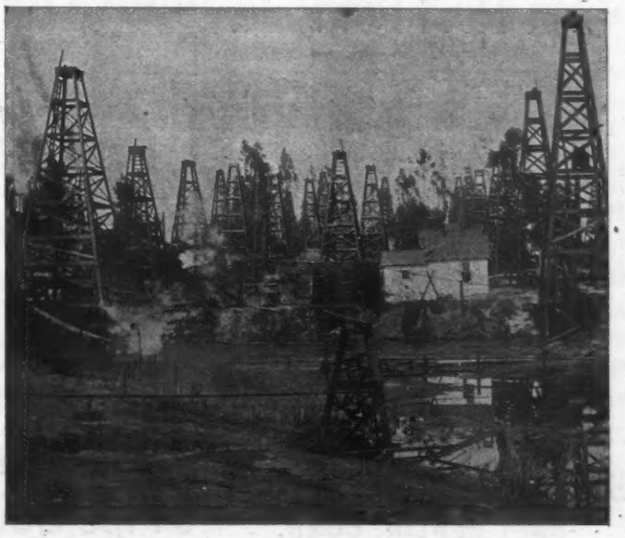
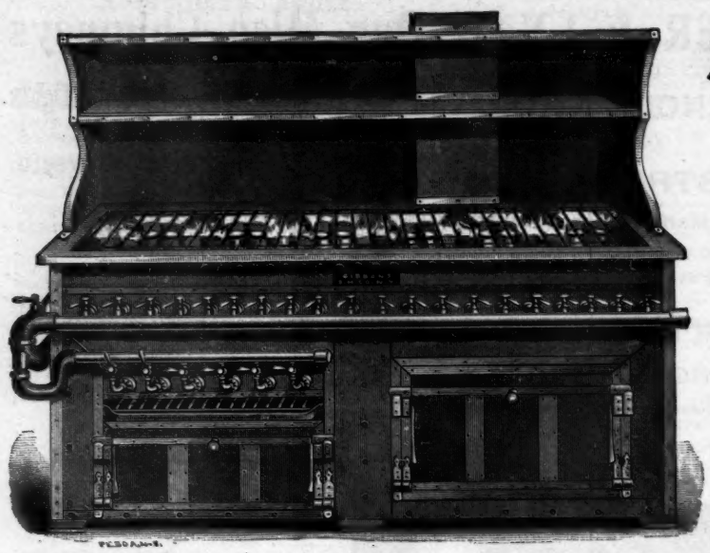
Now is the time to invest, when the first capital will be able to double itself in a single year. This is also the most delightful residence section in the United States.

We suggest to those desiring gas investments, in large or moderate amounts—with or without active business connections—to come here and investigate; or, what is the next best thing, write us for particulars and prospectus.

The accompanying cut shows the oil wells in the suburbs of Los Angeles from which the Companies under the NEW LOWE GAS PROCESS obtain their supply of oil.



AMERICAN GAS & COKE CO. (T. S. C. Lowe, Manager),
406 Bradbury Building, Los Angeles, California.



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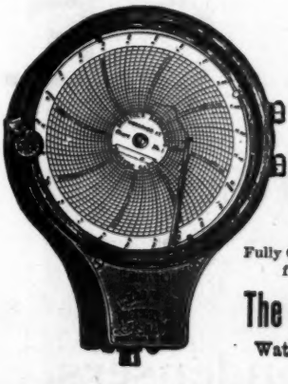

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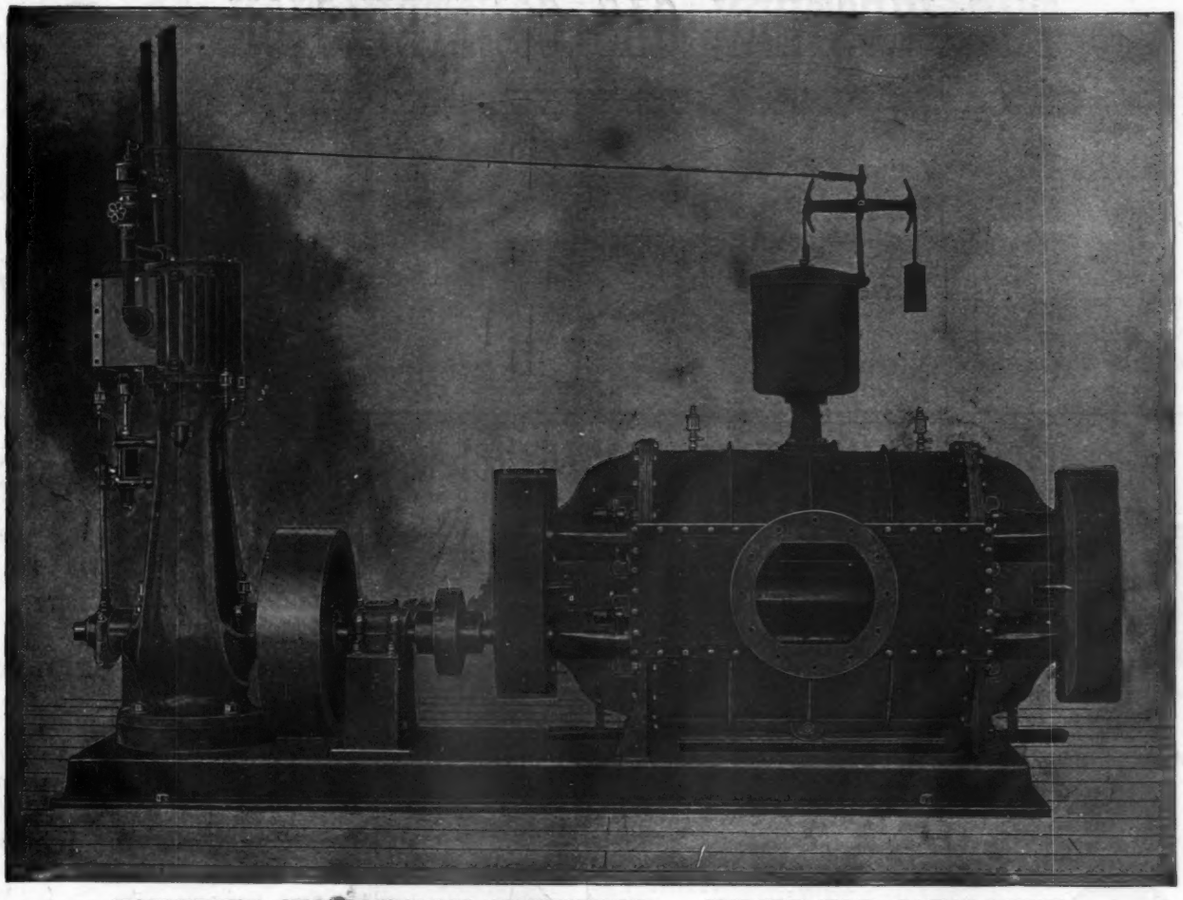

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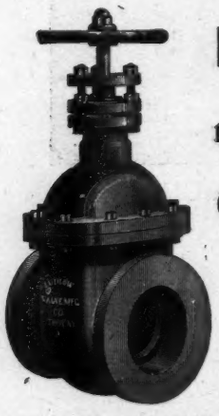

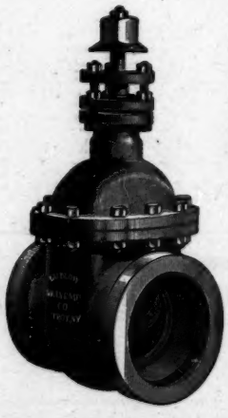

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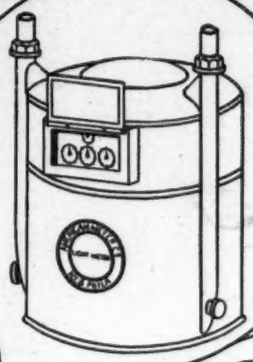
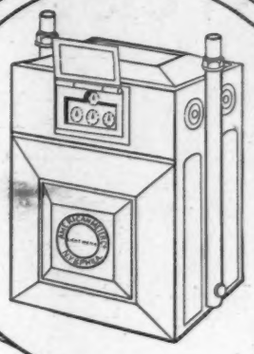
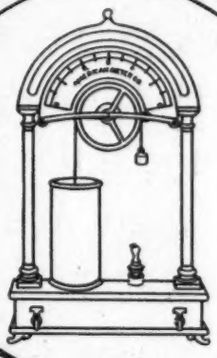
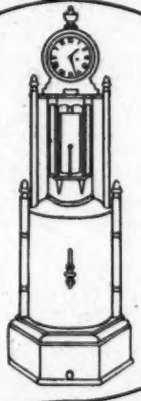
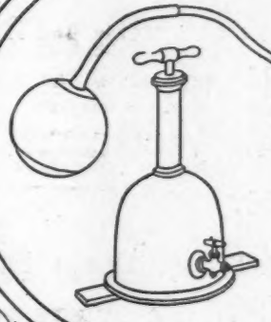
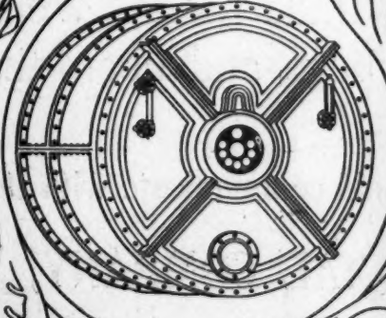


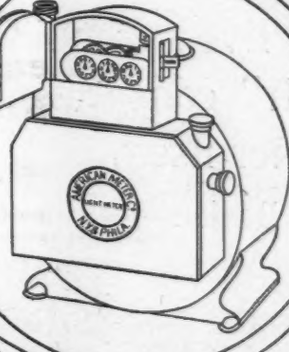












PUBLIC LIGHTING TABLE.

JUNE, 1898.

Day of Week.	Table No. 1. FOLLOWING THE MOON. Date.	Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light. P.M.	Extinguish. A.M.
Wed.	1	1.30 AM	3.30 AM	7.15	3.15
Thu.	2	2.20	3.30	7.15	3.15
Fri.	3	No L.	No L.	7.15	3.15
Sat.	4	No L. FM	No L.	7.25	3.15
Sun.	5	No L.	No L.	7.25	3.15
Mon.	6	8.00 PM	10.50 PM	7.25	3.15
Tue.	7	8.00	11.30	7.25	3.15
Wed.	8	8.00	12.00	7.25	3.15
Thu.	9	8.00	12.30 AM	7.25	3.15
Fri.	10	8.00 LQ	1.00	7.25	3.15
Sat.	11	8.00	1.20	7.25	3.15
Sun.	12	8.00	1.50	7.25	3.15
Mon.	13	8.00	2.10	7.25	3.15
Tue.	14	8.00	2.40	7.25	3.15
Wed.	15	8.00	3.30	7.25	3.15
Thu.	16	8.00	3.30	7.25	3.15
Fri.	17	8.00	3.30	7.25	3.15
Sat.	18	8.00 NM	3.30	7.30	3.15
Sun.	19	8.00	3.30	7.30	3.15
Mon.	20	8.00	3.30	7.30	3.15
Tue.	21	8.00	3.30	7.30	3.15
Wed.	22	8.00	3.30	7.30	3.15
Thu.	23	9.10	3.30	7.30	3.15
Fri.	24	9.40	3.30	7.30	3.15
Sat.	25	10.00	3.30	7.30	3.15
Sun.	26	10.30 FQ	3.30	7.30	3.15
Mon.	27	10.50	3.30	7.30	3.15
Tue.	28	11.30	3.30	7.30	3.15
Wed.	29	12.00	3.30	7.30	3.15
Thu.	30	12.50 AM	3.30	7.30	3.15

TOTAL HOURS LIGHTING DURING 1898.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	210.40	January	423.20
February	186.40	February	355.25
March	181.20	March	355.35
April	166.10	April	298.50
May	156.40	May	264.50
June	144.30	June	234.25
July	147.30	July	243.45
August	157.10	August	280.25
September	169.50	September	321.15
October	186.00	October	374.30
November	204.30	November	401.40
December	218.30	December	433.45
Total, yr.	2129.30	Total, yr.	3987.45

Welsbach Patent Sustained.

INJUNCTION GRANTED.

Judge Townsend, in the United States Circuit Court for the Southern District of New York, has handed down a decision sustaining the Welsbach Light Company's Rawson patent, and adjudged **THE SUNLIGHT INCANDESCENT GAS LIGHT COMPANY** to be an infringer. This Company has been enjoined from the further use of its method of manufacture of incandescent mantles or the sale or use of the same, and ordered to render an accounting.

A further decision has been handed down by Judge Lacombe in the United States Circuit Court, granting a motion for a similar injunction against **THE REX INCANDESCENT LIGHT COMPANY.**

Every other manufacturer of incandescent mantles in the United States is under these decisions an infringer of this patent, and the Welsbach Light Company will proceed against them at once.

We again caution gas companies and the public generally against the purchase of any incandescent mantle other than that made and sold by the Welsbach Light Company or its agents.

Every genuine Welsbach lamp has the trade mark "Welsbach" conspicuously printed upon the package and upon the burner itself.

Dealers desiring to handle the genuine article should communicate with the

WELSBACH COMMERCIAL COMPANY,

Drexel Building, Philadelphia.

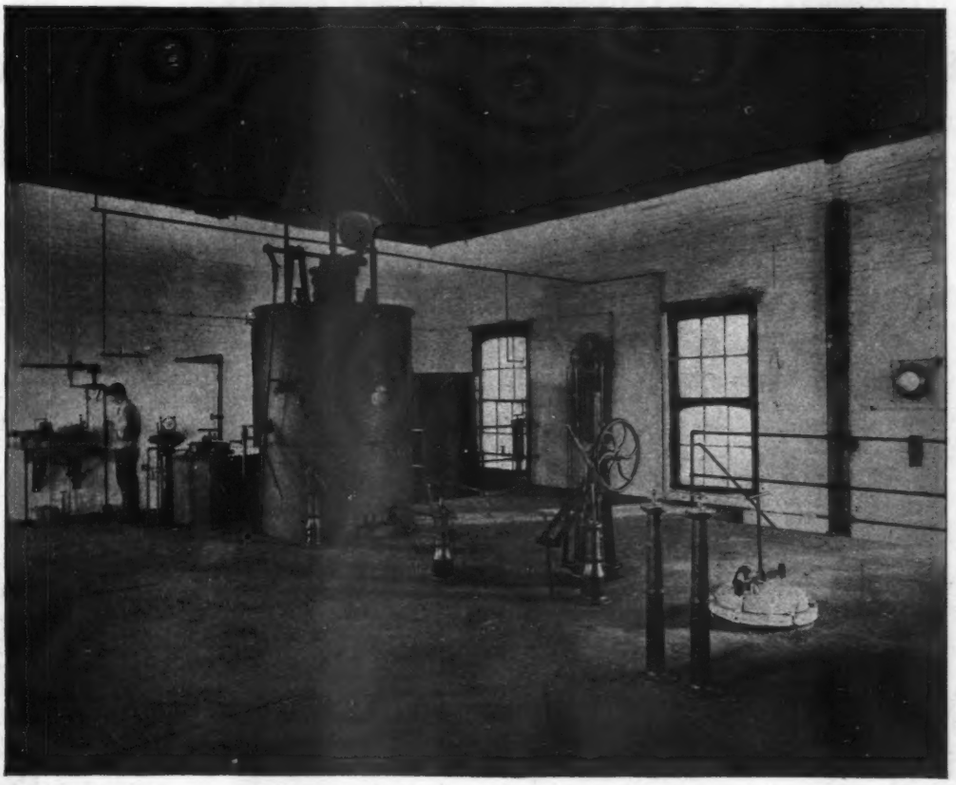
The United Gas Improvement Company,

DREXEL BUILDING, PHILA., PA.

The Standard Junior,

The Standard Double Superheater,

LOWE WATER GAS APPARATUS.



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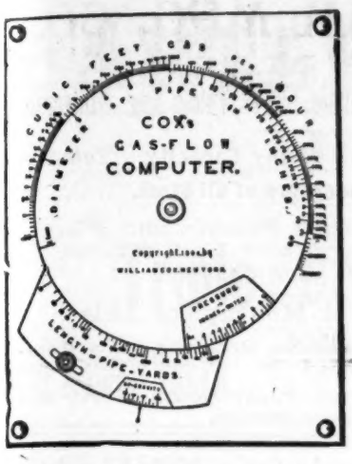

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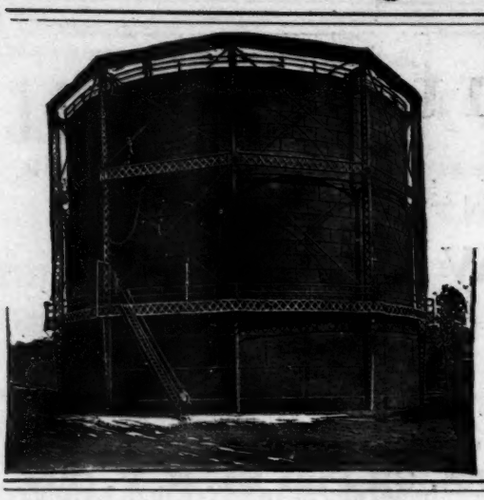

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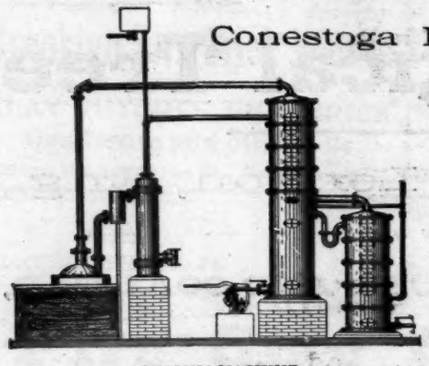

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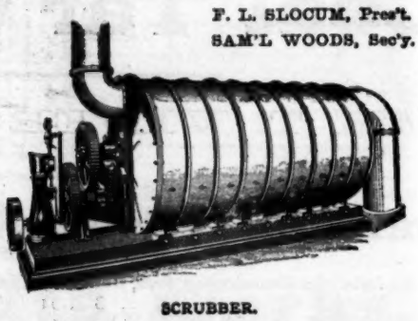

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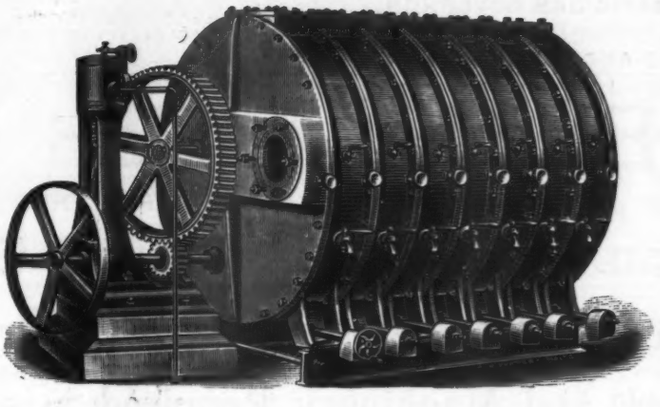

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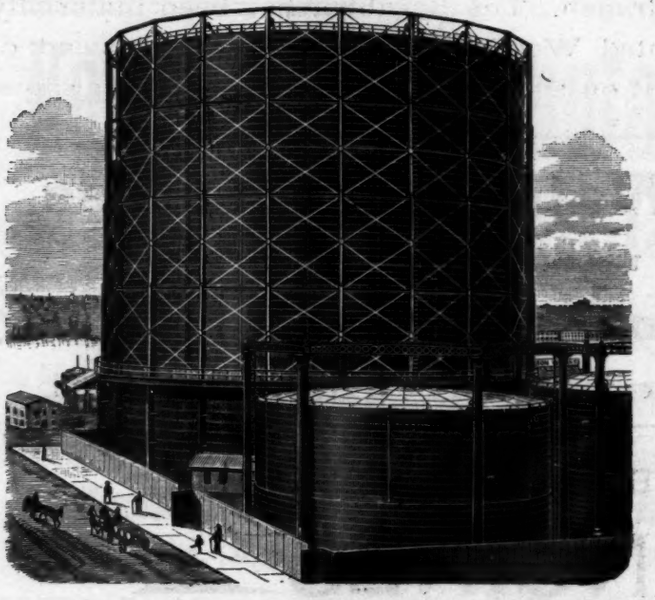

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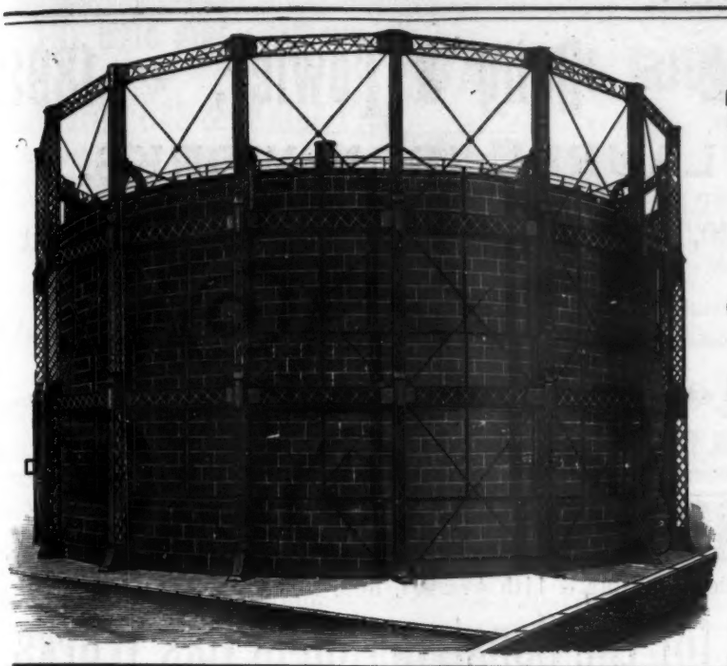

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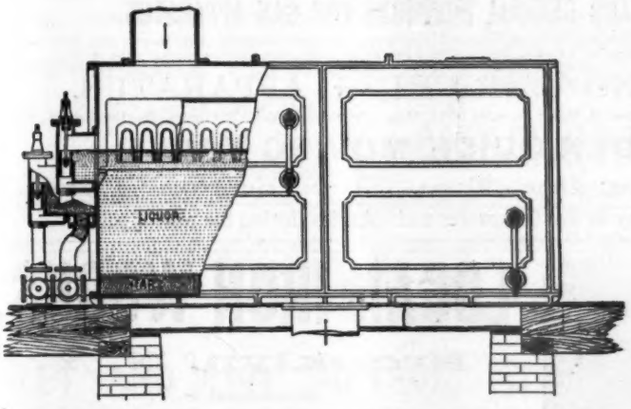

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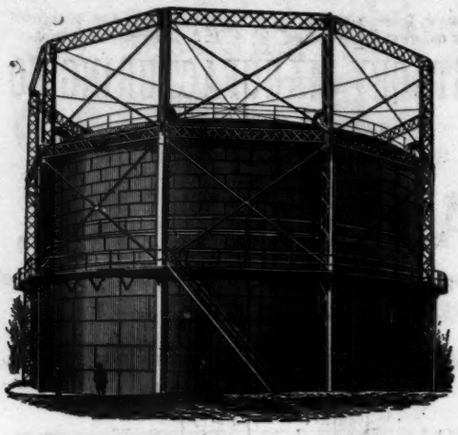

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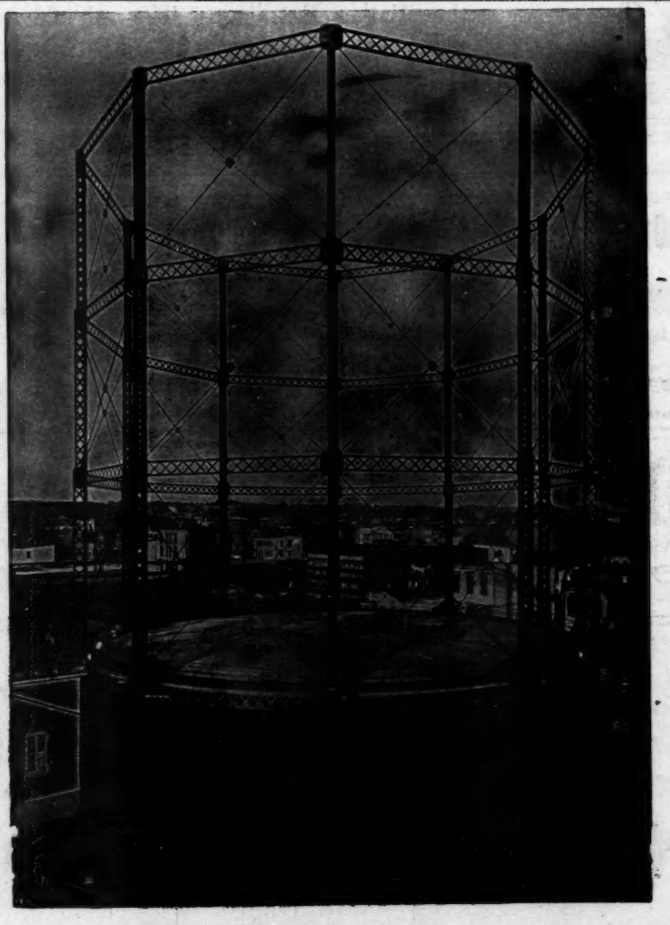

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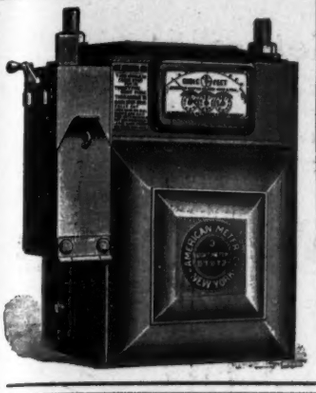

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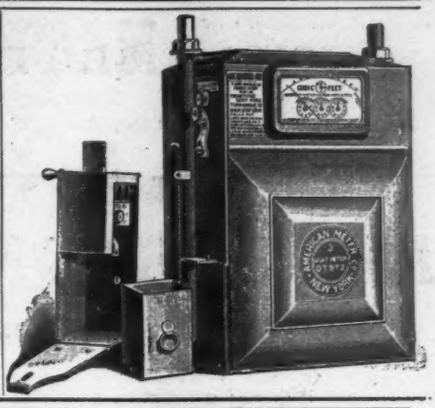

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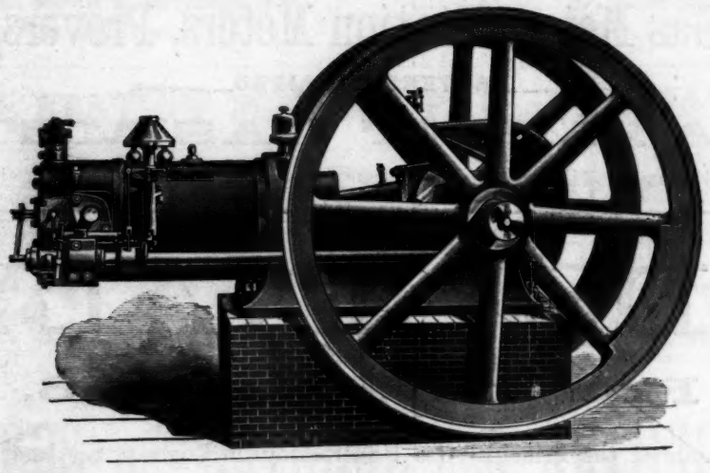

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